Lectures on General Anæsthetics in Dentistry

De FORD

Dr F. Austin Roy.

from

[illegible]

Xmas. 1913

DR. HORACE WELLS.
Discoverer of Surgical Anæsthesia.
(Nevius)

LECTURES

ON

General Anaesthetics

IN

Dentistry

Advocating Painless Dental Operations

By the use of

Nitrous Oxid, Nitrous Oxid and Oxygen, Chloroform, Ether, Ethyl Chloride and Somnoform

BY

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SECOND EDITION

WITH ILLUSTRATIONS

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DEDICATION

To

JESSIE RITCHEY DeFORD, D.D.S.,

In recognition of her ability as a skilled anæsthetist and valued co-laborer, I dedicate this volume.

PREFACE TO SECOND EDITION.

The fact that a book is well received is more gratifying to an author than financial returns.

The first edition of this book was exhausted last summer, and since that time there have been more inquiries and orders for the book than at any time during its existence. This in itself would be a sufficient reason for another edition. A better reason, however, is the fact that during the past few months a number of anæsthetic appliances of superior design have been introduced, greatly simplifying the administration of anæsthetics, making the administration of anæsthetics less hazardous, and securing more gratifying results for both patients and operator.

The manufacturers of nitrous oxid and oxygen have revolutionized their method of handling these agents. It is possible now to obtain cylinders containing from twenty-five gallons to thirty-two hundred gallons of nitrous oxid and the amount of oxygen corresponding. The larger cylinders are equipped with pressure gauges, insuring an even and constant flow of the anæsthetic at all times. A table in conjunction with an indicator showing the number of gallons remaining in the cylinders relieves the anæsthetist of the anxiety formerly experienced every time an administration of nitrous oxid and oxygen was to be made, lest the cylinders might not contain a sufficient quantity of material to complete a given case.

The fact that nitrous oxid can now be obtained in such large cylinders, that the gas can be made to flow steadily at a given pressure, and a gauge has been devised indicating at all times the amount of gas remaining, overcomes in a measure the objections to nitrous oxid-oxygen anæsthesia.

Since the last edition of this book was issued the somnoform formula has been revised, making it theoretically safer but in no way diminishing its efficiency as an anæsthetic agent.

A new somnoform appliance has been devised, increasing the possibilities of this anæsthetic. By means of this appliance, when the stage of analgesia or anæsthesia is reached, it is no longer necessary to remove the appliance from the face, but the patient continues to inhale the anæsthetic through the nose, thus maintaining the stage of anæsthesia or analgesia desired. Recent investigations of Yandell Henderson and others showing that instead of being a waste and deleterious product carbon dioxid is one of the most important of the body's hormones, "exercising a regulating influence on the action of the heart, on the tonus of the blood-vessels, and especially on respiration," is the most important discovery in half a century in the realm of anæsthesia, and bids fair to revolutionize anæsthetic administration.

In the light of these advancements we feel that another edition of this book is justified.

Drake University, Des Moines, Ia.

W. H. DeFORD.

June, 1912.

PREFACE TO FIRST EDITION.

At the request of **Dr. Burton Lee Thorpe,** associate editor of **The Dental Brief,** the writer prepared for that journal a series of articles entitled "Anæsthetics in Dentistry." From time to time during their publication numerous letters were received from all over this country and abroad inquiring if these articles would be published in book form.

So many inquiries of this kind have come to hand as to create the impression that a practical treatise on anæsthetics was very much needed. Instead of reproducing in book form what has already been printed in the Brief, the author has used those articles as a skeleton about which he has woven the fabric which constitutes these brief lectures.

The object of this book is to give the busy dentist **a working knowledge of such general anæsthetics as can be used to advantage in daily practice.** With this end in view, the author has prepared what he has to say in the form of brief lectures. The "how" is dwelt upon more than the "why"; in other words, it is simply a practical treatise, and not a theoretical exposition.

The lecture style enables the author to talk directly to the individual just as is done in the class-room and to repeat and emphasize from time to time the more important and essential things, which is not permissible in a text-book.

Hewitt has been quoted frequently; his text-book, entitled "Anæsthetics," in my opinion, is the best that has ever been written on this subject. Brunton, Luke, Buxton, Crile and others have been consulted, and, likewise, papers and clinical reports published in **The Medical Association,** current literature in medical and **British Medical Journal, Journal of the American** dental journals, etc., etc.

The author is also indebted to the S. S. White Dental Manufacturing Company, E. de Trey & Sons, the Lennox Chemical Company, A. C. Clark & Company, Teter Manufacturing Company, and Dr. Laird W. Nevius for the cuts of the various dental appliances used in these pages. W. H. D.

Hotel Victoria, Des Moines, Iowa, April, 1908.

CONTENTS.

LECTURE I.

HAS THE DENTAL SURGEON THE RIGHT TO ADMINISTER GENERAL ANÆSTHETICS?

LECTURE II.

THE VALUE OF GENERAL ANÆSTHETICS TO THE DENTAL SURGEON.

LECTURE III.

TO WHOM IS IT SAFE TO ADMINISTER AN ANÆSTHETIC?

LECTURE IV.

ELEMENTS OF DANGER.

LECTURE XXI.

Ether and Chloroform.

LECTURE XXII.

Difficulties and Dangers Incident to Administering General Anæsthetics in Dental Practice, and How to Meet Them.

LECTURE XXIII.

Difficulties and Dangers Incident to Administering General Anæsthetics in Dental Practice, and How to Meet Them.—Continued.

ILLUSTRATIONS.

THE REASON THE PATIENT SO RARELY GOES BEYOND THE BORDER-LINE LIES NOT SO MUCH IN THE AGENT EMPLOYED AS IN THE SKILL OF THE EXPERIENCED ANÆSTHETIZER, WHO KNOWS THE PROPERTIES OF THE DRUG HE USES; WHO, AFTER A THOROUGH EXAMINATION, HAS TAKEN ALL PRECAUTIONS; WHO FORESEES ALL POSSIBLE "ACCIDENTS"; WHO WILL NOT TRUST TO LUCK; AND WHO REMAINS VIGILANT THROUGHOUT AND UNTIL THE PATIENT RETURNS TO CONSCIOUSNESS.—The Medical Times, Jan'y, 1908.

LECTURE I.

Has the Dental Surgeon the Right to Administer General Anæsthetics?

The mind of the dental surgeon is clear as to his right to put into practice everything taught in his alma mater, except general anæsthetics. He is taught operative dentistry, and operates on the teeth; he is taught prosthetic dentistry, and restores lost organs; he is taught orthodontia, and corrects irregularities of the teeth; he is taught materia medica and therapeutics, and prescribes constitutional remedies; he is taught the theory and action of general anæsthetics—but employs them not.

He hesitates not a moment to inject cocaine hypodermically into the gingival tissue, a procedure that is fraught with many, many times the risk he would be taking in administering nitrous oxid gas or somnoform. Surely, **if the dental diploma is worth anything, if it means anything, if there is any potentiality in it, it carries with it the right to do those things in the office of the possessor which are taught in the curriculum of his alma mater.**

In all other departments, dentistry has made wonderful progress, outstripping almost every other profession in the matter of advancement; yet, in this particular branch, anæsthetics, which should have, by

right of discovery and inheritance, excelled all other specialties of medicine, the dentist has been a laggard and a coward. By right of discovery and inheritance, because **the greatest benefactor the human race has ever known, Horace Wells, the discoverer of surgical anæsthesia, was a dentist. Morton, another dentist, was the first to discover the anæsthetic properties of sulphuric ether**; and it was Rolland, dean of the Dental School of Bordeaux, France, who experimented with various anæsthetic mixtures and gave us the combination which he designates **somnoform.** Had the rank and file of the dental profession followed in the footsteps of Wells, Morton and Rolland and made practical application of the truths these men gave us, dentistry would to-day be far in advance of its present status.

It is said of the Savior, He came unto His own, and His own received Him not; nevertheless, the despised, the rejected One became the Light of the World. So it has been with anæsthetics. The world is indebted to members of the dental profession for the discovery of the anæsthetic properties of nitrous oxid gas and ether; these anæsthetics, rejected by the dental surgeon, in the hands of the general surgeon have become the greatest boon ever bestowed upon suffering humanity. As the Jews will surely return to Jerusalem, **we should return to our own, claim it, appropriate it, make use of it, and reap the rewards.**

Surely, if anyone is entitled to administer anæsthetics, it is the dentist; not only because of the priority of discovery, but **because of the necessary pain**

inflicted to do his work properly. Has the dental surgeon the legal right to administer anæsthetics? Certainly. If he has received proper instruction in regard to the chemistry, physiological action, properties, and behavior of anæsthetics; if he has attended lectures on physical diagnosis, and passed a successful examination in materia medica and therapeutics, and possesses a diploma from a reputable dental college, why not? The intelligent, progressive dentist in the treatment of incipient alveolar abscess prescribes cathartics, diuretics, diaphoretics, etc.; in the treatment of pyorrhœa, dietary measures and eliminants; in facial neuralgia, anodynes and tonics; in pulpitis, opiates and soporifics; in dental caries, antacids and germicides—indeed, his materia medica vocabulary is as extensive, if not more so, than that of the ophthalmologist, rhinologist or laryngologist; yet the dental practitioner hesitates to avail himself of the usefulness of general anæsthetics.

Had Dr. Chapin A. Harris succeeded in making good the ambition of his life, this lecture would have been unnecessary. Dr. Harris was the founder of the Baltimore College of Dental Surgery, the oldest dental college in the world. In 1837, Dr. Harris appeared before the trustees of the University of Maryland Medical College and proposed that they should add to their curriculum the chairs of operative and mechanical dentistry, and those desiring to prepare themselves for the practice of dentistry should take the work of these two chairs in addition to the medical studies. His proposition met with flat refusal. The

following year he made another attempt, but the trustees denied his request; so, in 1839, he organized the Baltimore College of Dental Surgery. Had Chapin A. Harris been successful in having established dental chairs in Maryland University Medical School, **every dentist would have been a medical man and the D. D. S. degree unknown.** In keeping with such terms as otologist, rhinologist, neurologist, etc., we would have been designated **odontologists, and would have practiced under the M. D. degree,** and the question as to the right of dental surgeons to administer anæsthetics never would have been raised.

The dental surgeon, it is true, has never availed himself of all of his rights and privileges. He has not shown that broad professional spirit which should dominate him; he has not clasped hands, as he should have done, and become one with his brother, the medical man.

The subsequent conduct of the medical profession has been as magnanimous as it had been short-sighted and narrow, and it appears as though the medical profession has tried to right what might be denominated the crime of 1837-38, when the medical faculty of Maryland University refused to accept dental students on the terms proposed by Dr. Harris.

When the Ninth International Medical Congress convened in Washington in 1889, a Dental Section was organized, thus **placing the dental surgeon on an equal footing with the ophthalmologist, laryngologist, gynæcologist and other medical specialties.** Of the eighteen sections constituting that congress, seldom was a man

admitted to membership without the degree of doctor of medicine. About this time, the American Medical Association added a Section on Stomatology, the membership of which is composed of prominent dental surgeons. In case of a death during anæsthesia, would a coroner's jury or a court of justice say that a member of the International Medical Congress or a member of the American Medical Association had not the right to administer an anæsthetic? Membership in these associations is open to you, and if you are not a member of the dental section of one or both of these organizations, you have only yourself to blame.

The right to administer an anæsthetic, whether by a physician or a dentist, depends fundamentally upon the possession of the requisite knowledge, skill and experience. A dentist undoubtedly has the right to administer anæsthetics in his practice if he is competent to do so. But a dentist has not the right to administer anæsthetics unless he is familiar with their effects and can show his proficiency in this respect. If a dentist should have an accident or a fatality of such a nature as a coroner's jury or the courts of justice would take into account, his right to administer anæsthetics would be more strictly called into question than if a physician should have a similar accident. In the case of the physician, the community generally take it for granted that he is competent and experienced with anæsthetics; whereas, if a dentist had a mortality in his office, they would probably think that he was not so competent and experienced in the use of anæsthetics. Hence, the dentist who is adminis-

tering anæsthetics, or who contemplates doing so, should surround himself with every possible safeguard. If he is a recent graduate, or has only been in practice a few years, and his *alma mater* gave only a theoretical course of instruction in general anæsthetics, and if, upon the witness stand, he would have to state that, pror to engaging in practice, he had never administered an anæsthetic, he might be placed in a very compromising position. Such a dentist should, for his own protection, go to an anæsthetist of recognized ability and take practical instruction in administering anæsthetics. As medical and dental colleges seldom provide such instruction, there is no other alternative. This would apply equally to the middle-aged man, or, in fact, to any dental practitioner who desires to avail himself of the use of anæsthetics in his practice, if he has not had previous practical experience. He owes this much, not only to himself, but to the community in which he lives, and to those who place their lives in his keeping.

In case of an accident, inquiry will also be made as to what antidotes and restoratives were at command when needed, what measures of resuscitation were used; so it behooves a dental practitioner to keep himself well informed and abreast of the times if he administers anæsthetics.

A dentist has a right to administer general anæsthetics in his practice, unless there is a statute to the contrary; provided, as previously stated, he can show that he is competent and possesses the requisite skill, knowledge and experience. Davy Crockett used to say,

"Be sure you are right, then go ahead." This is applicable to the present case. Properly prepare yourself to give anæsthetics; have a good working knowledge of the physiology of the lungs, heart and kidneys; study the anatomy of the nerves that control circulation and respiration; make yourself at home with the various methods of artificial respiration; then go ahead fearlessly, calmly, knowing that you will be ready in any emergency, and, in case of an accident, you will be ready to face the highest court of all, your own conscience.

The question often arises: Would the dentist be held liable for the consequences if a death should occur while he is administering an anæsthetic, or as the result of an anæsthetic administered by him? The answer turns on the right of the dentist to administer the anæsthetic. The test, in each instance, is whether or not **the dentist has used such care and skill in the administration of the anæsthetic as would be exercised by the average dentist** practicing in the same locality. If the work that is undertaken is within the scope of the dentist's practice, and the substance administered is one which has been given a reasonable test, and if proper diligence and skill are brought to the treatment of the case, **the dentist would not be held liable for a death which might result.**

Neither a dentist or a physician has any right to experiment with new appliances or anæsthetics which have not been properly tested. Nor would a dentist have a right to use an anæsthetic unless familiar with its effects, and was competent to administer it. I am

presuming that this is a part of the course of study in every modern dental college, and that the dentist must show his proficiency in this respect before he is admitted to practice in his State.

It has been held that "where a person, who had a few days previously received a severe blow on the head, called upon a dentist for the purpose of having some teeth extracted, and which were extracted by the dentist after the administration of chloroform, **the dentist was not liable for a total stroke of paralysis** which resulted a few days later, **the court being of the opinion that the dentist could not be held liable for consequences that he could not reasonably foresee,** and which were not the ordinary or probable result of what he did." (**Bogle vs. Winslow,** 5 Phil. Pa., 136.)

It has also been held that **a dentist is not held to insure the result of his work, nor is he responsible for a mistake of judgment where he exercises reasonable skill and care.** (**Wilkens vs. Ferrell,** 10 Tex. civ. app., 231.)

LECTURE II.

The Value of General Anæsthetics to the Dental Surgeon.

Anæsthetics have dignified medicine; anæsthetics have made surgery. Anæsthetics can do nearly, if not quite, as much for the dental surgeon if he would avail himself of their kind offices. The general surgeon administers an anæsthetic, primarily, to prevent pain and avoid shock; secondarily, to facilitate operating. In some cases, the patient could undergo the operation without an anæsthetic, just as the dental surgeon compels his patients to undergo the severest of pain in his chair. The general surgeon administers anæsthetics to prevent shock, for it is shock, surgical shock, that kills.

Prior to the general use of anæsthetics, deaths were frequent in simple arm and leg amputations, while now, under anæsthesia, one seldom hears of death during these operations. It was shock that killed them. Thousands of brave soldiers in the Civil War, wounded by the enemy, died on the field of battle before medical assistance could reach them, not from hemorrhage, not because a vital part was entered by bullet or shell, but from shock, the result of intense pain. **Anæsthetics,** then, **are used primarily to prevent**

pain and to avoid shock. In this enlightened age no surgeon, except the dental surgeon, permits a patient to undergo, without an anæsthetic, tortures equal in severity and duration one is subjected to during the average dental operation. Through apprehension that the instrument may slip and enter the soft tissues, or fear that a bur may accidentally plunge into a live pulp, patients are subjected not only to physical pain, but to mental suffering as well. Thus the nervous system is at its highest tension, and the patient often leaves the chair fatigued, exhausted, sometimes bordering on a state of collapse, and at each subsequent sitting the strain is greater. That is not all. Upon retiring, the nerves take up the impression made upon them, and all night long, in effect the dental bur is whirling at lightning speed; the corundum-wheel is grinding sensitive dentine; the sandpaper strip is drawn rapidly between the teeth, setting them on fire, as it were, and there is no rest even in the quiet of the night.

Exhaustion of the vaso-motor centers, rather than structural lesions, is what produces shock, and I want to emphasize the fact that it is a dangerous procedure to submit even the physically strong to intense pain beyond certain limits. Under the benign influence of anæsthesia, physical suffering is prevented, mental torture obviated, and the patient steps from the chair without fatigue, and an otherwise restless night becomes one of sweet repose and refreshment. If we only knew, if there was any way to ascertain just how much the dental surgeon contributes to the sum total

of the neurasthenia which is so prevalent at the present time, it would be interesting, but "where ignorance is bliss, 'tis folly to be wise."

We are all familiar with such expressions as, "It used to be that I did not mind having teeth filled, but the very thought of it now gives me a nervous chill; I have no nerve any more"; "I had rather die than have this tooth out, and I hoped that I would before it was necessary to have another extracted"; "I have never recovered from the last time when I had several out without taking anything"; and kindred remarks. **The nervous system has been impaired by previous operations, and the old impressions of suffering and exhaustion are awakened at the very thoughts of taking the dental chair.**

Bold in other directions, commendably progressive in all that relates to manipulative ability and artistic development, the dental surgeon shrinks from anæsthetics. He cuts into living tissue, lacerating the nerves themselves, "performing laparotomies upon the teeth," so to speak, and the anæsthetic usually employed is that of witty speech, or an amusing story, while the patient suffers, cringes, agonizes almost to the state of collapse.

The dental surgeon does not seem to realize the extent to which the nervous system is impaired as the result of operations on the teeth. After prolonged operations the neurons become exhausted and there is a condition which I denominate **dental fatigue**, bordering on collapse or shock. When a patient returns to the office and remarks that he was completely used up,

after the last sitting, the dentist makes light of it, laughs it off, adjusts the rubber dam and begins the nerve-racking procedure for another hour or two. Fortunately, I have been almost immune from dental caries and have spent but few hours in the dental chair in a lifetime, and my case is hardly a fair example of that dental fatigue which results from painful operations, or operations of long duration, even though not very painful. However, I had one experience when a dental student in college that I have never forgotten. The professor of operative dentistry built up with gold an impaired lower molar. The sitting was from ten o'clock until one. I had expected to operate that afternoon at the clinic, but so exhausted, so fatigued was I at the conclusion of the operation that I went to my room and remained there in bed from one o'clock Saturday until Monday morning. Ten years elapsed before it was necessary to again become a patient. This time caries had so nearly approached the pulp in an upper bicuspid that it was necessary to expose and devitalize the formative organ of the tooth. Thousands of times had I sent patients to their homes with an arsenical application on or in close proximity to the pulp, but not until I experienced the effects of that little 1-100 of a grain of arsenious acid, smothered in sulphate of morphia and cocaine, did I realize the weight of woe that I had unsuspectingly contributed to suffering humanity. That dose laid me up for a day and a half. When I contemplate those more unfortunate patients where the operations on their teeth require two or three sittings a week for a period

of several weeks, and others who find it necessary to visit a dental surgeon every six months for professional services, I am satisfied that more humanitarian methods should be adopted. The dentist should take into consideration the physical well-being of his patients and adopt those methods which are the least destructive of nerve force and vitality.

The general surgeon employs anæsthetics, secondarily, to facilitate operating. Imagine, if you can, that, on awakening on the morrow, the knowledge of all anæsthetics was lost to man, and that their formulæ or component parts were blotted out from memory. Picture surgeons, Samson-like, shorn of their strength, as they watch patients and nurses assemble at the various hospitals. Where is the surgeon who could operate successfully under these conditions? Without anæsthetics, the occupation of the surgeon would be gone and the hospitals would have to be converted into sanitariums and asylums, where suffering humanity must wear itself out in pain and misery.

General anæsthetics in dentistry can be made to play a double part—save the patient from suffering and nerve strain, and relieve the operator of the debilitating influences incident to controlling patients, highly nervous and hysterical, who sap his energy, absorb his vitality, and deplete his mentality.

Some twenty years ago, in Chicago, while visiting the office of a dentist, who has ever since been a warm personal friend, I beheld that which impressed me deeply. Although for ten years previously I had been interested in anæsthetics and gave the

subject as much time and attention as a busy practitioner could well bestow upon it, it was not until the summer of 1893 that I fully awakened to the possibilities of general anæsthetics in dentistry.

In this office were two chairs, each presided over by a lady assistant. Upon completing an operation the chair was vacated and another patient called, the operator passing quietly from one chair to another. This dental surgeon refused to operate for anyone who would not inhale a general anæsthetic, and he informed me that he averaged twenty administrations a day. He maintained that under chloroform analgesia the patient was saved the suffering and shock incident to such operations without anæsthetics; that he was enabled to make a more thorough cavity preparation, and he could accomplish in a few minutes, under anæsthesia, or analgesia, results which would require a long sitting without the aid of an anæsthetic. Although he was a man well advanced in years, three score years and ten, he said that he was enabled to accomplish this amount of work only because it did not tire him to operate when he could proceed with as much assurance as though he was operating on an inanimate substance.

I recall an operation that greatly interested me. A young lady presented with pyorrhœa. One central incisor had elongated fully a quarter of an inch; indeed, when the lips were closed naturally, the tooth projected so as to be seen. He said to me: "What would you do in this case?" I replied in jest: "Take a hammer and drive it back on a line with the other

teeth." He replied: "That is just exactly what I will do." He administered chloroform, extracted the tooth, enlarged the alveolar socket, removed the pulp from the tooth, filled the root canal, placed the tooth in its socket, drove it to place with a hammer, made a splint and adjusted it, and the time consumed, from the first inhalation of chloroform until the patient left the chair, was just eleven minutes. Without his knowledge, I had timed this operation, and he operated and talked and explained as one does at a clinic, showing no haste.

In those cases where caries approached the pulp to such close proximity as to render inflammation and death of the pulp liable as the result of a filling, it was the custom of this dentist to administer chloroform, open into the pulp chamber and amputate the bulbous or crown portion of the pulp with a large bur. Upon the cessation of hemorrhage he burnished gold foil over the stump, leaving the root portion alive, filled with cement, and in the course of two or three months completed the operation.

I saw him operate on several of these cases and the patients assured me that they experienced no pain. I also saw cases which had been operated on for pulp amputation months previously and the teeth showed no signs of discoloration, and they responded to heat and cold, showing that the pulps were alive, maintaining the natural color of the teeth and preventing the formation of alveolar abscess.

Attention had been called to the fact that Dr. A. C. Hewett, of Chicago, for it was he to whom I refer, was

operating on teeth under chloroform analgesia, and he had delivered addresses on two occasions before the Iowa State Dental Society. So impressed was this society with the claims made by this speaker that a committee was appointed to go to Chicago and investigate his work. I was fortunate in being made a member of that committee and wrote the report, which was published in full in the proceedings of the Society for the year 1892.

During the three days spent with Dr. Hewett on that occasion, the committee witnessed almost every operation common to dentistry, and not in a single case operated on was there an alarming symptom, nor was there nausea or delay of any kind incident to the anæsthetic.

Here was food for thought; here was something worthy of taking home; here was something worth putting to the test. Beginning at first with favorable cases, I found in a few weeks that chloroform worked as happily for me as for Dr. Hewett.

This was a glimpse of the promised land, a boon alike to both dentist and patient. Each year the conviction that the dentist should become proficient in administering anæsthetics and should employ them in his daily practice, has steadily grown.

General anæsthetics in dentistry are valuable to the dental surgeon and may be used for the following purposes:

First: To prevent pain, thus eliminating fatigue, collapse and shock.

Second: Short sittings are made possible, which is beneficial to both dentist and patient.

Third: Enables the operator to do more thoroughly the operation to be performed.

Fourth: Enables the operator to accomplish an increased amount of work in a day.

Fifth: Dignifies dentistry, elevating it to the plane of surgery, and augments the receipts of practice.

It is true that much of the supposed hurt is imaginary, purely mental, but that fact does not make it any easier for patients. It is real to them, and even the anticipation of being hurt disturbs the equilibrium of the nervous system. In many cases the vibrations resulting from the contact of bur with dentine or enamel, even where there is no pain, are sufficient to unnerve the patient during the entire operation. It is worth while to employ anæsthetics in these, if in no other cases, for these patients consume the greater portion of the operator's time as well as his strength. How often do you feel completely exhausted after performing some simple operation for a nervous, hysterical patient, and almost wish that he would never present himself again for an operation? Anæsthetize such patients, give them the bliss of anæsthetic relaxation, if not of unconsciousness, and they will prove to be quite model patients.

General anæsthetics can be employed to advantage in the following cases:

1. Adjusting the rubber dam where cavities of decay are to be excavated along the gingival margin

and a cervical clamp employed to hold the dam in position.

2. Cavity preparation for fillings and inlays.

3. Removing fillings in cases of pulpitis.

4. Exposing live pulps and immediate removal of same.

5. Opening into teeth in cases of acute pericementitis or acute alveolar abscess.

6. Instrumentation and application of caustics in pyorrhœa.

7. Lancing abscesses.

8. Extracting teeth.

9. Other painful operations, and operations the nature of which produce dental fatigue.

10. Oral surgical operations, such as cleft-palate, hare lip, empyemia of antrum, impacted third molars, dentigerous cysts, adenoid vegetations, alveolar and maxillary necrosis and various tumor formations in and about the mouth.

LECTURE III.

To Whom it is Safe to Administer an Anæsthetic.

Having shown that the properly qualified dental practitioner has the right to administer general anæsthetics in his daily work and pointed out the possibilities and advantages of operating on patients during anæsthesia or analgesia, the question naturally arises, to whom is it safe to administer an anæsthetic? There is a mistaken idea on the part of both the profession and the laity as to whom it is safe to administer anæsthetics. A widespread impression prevails that if the heart is sound there can be no risk, **"whereas in about ninety per cent. of the fatalities from chloroform, at the post-mortem examinations, the heart is found to be perfectly normal."** (Luke.)

Dr. Ochsner, in the last edition of his "Clinical Surgery," says: "In my experience, **patients suffering from organic heart lesions have never had any serious or alarming difficulty during the administration of anæsthetics,** which is not true of patients whose hearts, lungs and kidneys were evidently normal."

"It is a remarkable fact that an individual whose health has become impaired by disease is often a better subject for an anæsthetic than one who enjoys robust health. Although his heart and lungs may be in

excellent condition and able to stand almost any strain, yet he will not pass so easily into anæsthetic sleep as a less robust patient, owing to the more frequent occurrence of struggling excitement which will interfere with the respiratory rhythm." (Luke.)

Richardson thinks "the bad effects of anæsthesia are largely due to over-confidence and non-experience of administration." He has never seen a death from ether itself, and he thinks that while there may have been some, the number is extremely small. Only urinary suppression and pneumonia seem to him important. Where a patient dies after a severe operation, even with these symptoms, it is an unwarrantable assumption that death was due to the anæsthetic and not the operation.

Accidents from the subcutaneous or hypodermic use of cocaine would be much more perilous than ether accidents; the former would be caused by the intrinsic danger of the drug, the latter from disregard of danger signals, or over-etherization.

Heart disease is usually regarded as a contra-indication to general anæsthesia, but that is not according to his experience. His chief anxiety has been from diseases of the lungs; but he is inclined to think that his anxiety is seldom justified by facts. Failure to breathe is a serious matter, and it is fortunate—and in this fact lies the great safety of ether—that a patient with healthy lungs, at least, always reacts to artificial respiration.

As a rule, simple weakness does not contra-indicate anæsthesia. Of the two classes of patients—the

strong, robust, full-blooded with bounding pulse, and the frail, delicate, weak, even those that might be denominated invalids, **I much prefer the latter for anæsthesia.** About half of those who come to me to be anæsthetized complain of heart trouble, and these are the patients that cause me the least anxiety. Many volunteer the statement that their physician has warned them never to take an anæsthetic—these prove good subjects, also. But those patients who take the chair saying, "My heart is sound, my lungs are all right, you better get some one to help hold me or I may make you trouble"—**patients with strong physiques and active brains—these are the cases that require the greatest care and skill in administering anæsthetics.**

An experience of thirty years with the more commonly used general anæsthetics has convinced me that **the heart is rarely, if ever, primarily affected.**

I have seldom administered ether or chloroform for a major surgical operation, that, at some stage of the anæsthesia, the patient did not momentarily cease breathing (nothing serious), but never have I known the heart to cease beating or witnessed a fatality.

I am strongly of the opinion that **general anæsthetics cause the respiration to fail before the heart becomes affected,** and we all recognize the fact that it is much easier to re-establish breathing than to re-establish the circulation. There is no higher authority on this subject than T. Lauder Brunton, who was chairman of the Hyderabad Commission, who says: **"So far as the anæsthetic is concerned, in**

99,999 out of 100,000 cases it causes the respiration to fail before it affects the heart, and if you attend to the respiration carefully I do not believe you run very much risk of the heart. But remember that I make this statement only in regard to the anæsthetic, for shock may have a different effect."

We have been taught or impressed by the literature extant on anæsthetics that it is safe to administer ether if the lungs are sound, and safe and proper to administer chloroform when the heart is normal. If this were true, it would simplify the matter of selecting the proper anæsthetic each time for a given case, but the human race is not divided into two classes, one with sound hearts and the other with sound lungs. Luke claims that in ninety per cent. of the deaths occurring during chloroform anæsthesia the heart was perfectly normal. As to the number of fatalities of those possessing sound lungs under ether anæsthesia, I have no statistics at hand, but I doubt not the percentage would be as high, for **I am satisfied that in neither case is the ether or chloroform per se responsible for these deaths.**

It is impressive to state that in the case of sound lungs administer ether, and in the case of normal heart administer chloroform; but you will frequently find in the same patient an impaired heart, a tubercular lung, a diseased kidney, a shattered nervous system, yet an anæsthetic must be administered because of some gynæcological complication or an inflamed appendix. A well-known writer on anæsthesia says: "You must not administer ether in bronchitis or inflam-

matory conditions of the pulmonary tract, in acute or chronic nephritis, aneurism, atheroma, endocarditis, and high-tension pulse, in operations on the brain, in operations on the pelvic cavity, because it does not as thoroughly relax as chloroform, or to those addicted to alcohol or narcotics."

"Chloroform is contra-indicated in empyemia with dilatation of the right side of the heart, fatty degeneration of the heart muscles, dilatation of the heart with corresponding hypertrophy, in extreme prostration, in anæmia or shock, collapse, hemorrhage, very stout subjects," etc., etc.

Indeed, it would require a page to enumerate the conditions contra-indicating anæsthetics; yet thousands of operations are performed daily for patients having one or more of these conditions and a mortality rarely occurs. In some hospitals ether is used almost exclusively, in others chloroform. The matter of preference is confined not only to hospitals, but to sections of the country where one anæsthetic or the other will be used almost invariably **independent of the physical condition of the patient.** One would naturally suppose that a patient having several of the conditions named could not safely take a general anæsthetic; but no surgeon refuses to operate for these cases, **yet deaths are so rare under anæsthetics that many prominent surgeons have never witnessed a mortality.**

To whom it is safe to administer an anæsthetic becomes a perplexing problem when the strong, the healthy, the robust are more liable to accidents than

the weak, the frail and the patient in poor health; when eminent surgeons find that patients with impaired hearts, kidneys and lungs are safe, while those whose vital organs are in a state of health are liable to accidents. Further, notwithstanding a long list of pathological conditions, any one of which, we are told by some authorities, contra-indicates a certain anæsthetic, in the hands of other anæsthetists patients having these conditions are anæsthetized every day without accidents or subsequent trouble. How is one to intelligently determine to whom it is safe to administer an anæsthetic? In hospitals, and usually in private practice, a careful preliminary examination is made to determine the condition of the heart, lungs, and kidneys of the patient to be anæsthetized. This report is recorded on blanks made for the purpose and placed in the hands of the anæsthetist. He makes a study of this report and decides in advance the anæsthetic to be employed. If there are heart lesions, he knows it. If there are abnormal pulmonary conditions, he is aware of that. If albuminuria is present, the examination has shown it. The anæsthetist is ready for the battle, knowing, as it were, in advance, the weak places in the ranks of the enemy.

It is said, to be forewarned is to be forearmed. In cases of pathological lesions, the anæsthetist, knowing in advance what may happen, is careful to the minutest detail in the choice and the method employed in administering the anæsthetic. Never for a moment does he take his attention from the patient, watching for the least deviation from normal of the respiration, cir-

culation, and the pupil. This, to my mind, is the explanation when Dr. Ochsner says: "In my experience, patients suffering from organic heart lesions have never had any serious or alarming difficulties during the administration of anæsthetics, while this is not true of patients whose hearts, lungs, and kidneys are evidently normal." **The vital organs being pronounced normal, the anæsthetist is not so careful as to what anæsthetic he will employ.** He begins with a stronger vapor, perhaps, than he should, and pushes it along faster than in a less robust subject, and probably becomes interested in the operation himself, there apparently being no risk in regard to the anæsthetic, allows the patient to go down deeper than necessary, or to come out from under the influence of the anæsthetic, **not exercising that extreme care and watchfulness** he would if he knew his patient had a heart lesion. I am satisfied that it is **not the anæsthetic that is primarily responsible for accidents during anæsthesia when the accident is traced to the anæsthetic, but it is the fault of the anæsthetist, who has not properly administered the anæsthetic.**

Inexperience, ignorance, and carelessness on the part of the anæsthetist are responsible for more deaths than the action of all anæsthetics combined.

If it is true, as Luke says, that, "in about ninety per cent. of the fatalities that occur during chloroform anæsthesia, the post-mortem shows the heart to be perfectly normal," if chloroform was the cause of the death, the theory to administer chloroform when the heart is sound is erroneous.

Again, if the heart is found normal in ninety per cent. of chloroform fatalities, it looks as if **the fatal action must have manifested itself through some other organ than the heart.** It would hardly be the kidneys, and, eliminating the kidneys, **death must be caused by paralysis of the respiration.**

For years I have maintained **that respiration was the important thing to watch,** long before I knew that Brunton claimed that, in so far as the anæsthetic itself was concerned, in "99,999 out of 100,000 cases the respiration ceased before the heart's action." It is preposterous to hold anæsthetics so largely responsible for deaths that occur during anæsthesia, and I shall show in another lecture that only occasionally are deaths caused from anæsthetics, and these usually because the anæsthetic was not properly administered. I am aware of the fact that chloroform is a protoplasmic poison and ether a nephretic irritant; but the question is **not what ether and chloroform can do ad libitum, but what effect they have upon the tissues and organs of the body when used as anæsthetics, intelligently and properly administered.**

This chapter is written from a clinical standpoint, and, clinically, **the most important thing is to watch the breathing. Not for a moment should the attention of the anæsthetist be diverted from the respiration.** In the matter of observing respiration not only the eye but the ear can be trained to assist. Do not wait for something startling to occur, but the moment there is the least deviation from the normal institute measures to compel the patient to breathe properly.

"If you attend to the respiration carefully, I do not believe that you run very much risk of the heart. This statement refers strictly to the anæsthetic, for shock may have a different effect." (Brunton.)

From my standpoint, then, the question to whom is it safe to administer an anæsthetic for dental operations turns on the matter of properly administering the anæsthetic. It becomes a personal equation. The anæsthetist must be one who possesses the ability to inspire the patient with confidence, to allay all fear as to the probable outcome, and relieve the mind of all anxiety.

The psychical element is one of the most potent with which we have to deal. Timidity and nervousness on the part of the one who is to administer the anæsthetic is communicated to the patient, and unnerves him for the ordeal. You can not administer anæsthetics successfully unless you have confidence in both yourself and the anæsthetic and understand how to administer them.

I had rather take my chances on anæsthetizing a patient with valvular lesion of the heart, a morbid kidney, and an impaired lung, mind tranquil, than to anæsthetize a patient who takes the chair white with fear, gasping with short, quick breaths, circulation "off," with normal heart, lungs and kidneys. As I look back over an anæsthetic career of thirty years I can recall only a few patients to whom I have refused to administer an anæsthetic and the contra-indication in each case has usually been the psychical condition of the patient.

LECTURE IV.

Elements of Danger.

The elements of danger surrounding the administration of general anæsthetics may be classified as follows:

First: Ignorance, inexperience, and carelessness on the part of the anæsthetist.
Second: Length of duration of the anæsthesia induced.
Third: Physical condition of the patient to be anæsthetized.
Fourth: Shock.

In civic matters, ignorance of the law excuses no man. How important it is, then, that the anæsthetist, who, for the time being, takes the life of the patient into his own keeping and is responsible for it, should surround himself with all the safeguards and knowledge pertaining to this subject. One must familiarize himself with the various anæsthetic symptoms—to do less is criminal. It will be shown that deaths during anæsthesia are the result, in nearly all cases, of operating too soon, before the patient is properly anæsthetized; or operating too long, while the patient is coming out of the anæsthetic; or the anæsthesia in-

duced is not sufficiently profound to avoid shock, hence the paramount importance of knowing anæsthetic symptoms. Ignorance in these matters has resulted in sending thousands of patients to unnecessary graves.

Medical and dental colleges are at serious fault in that they do not compel their students to administer anæsthetics frequently, in the presence of competent instructors. It has been said that "The student can learn to administer anæsthetics after leaving school." The same could be said of the porcelain inlay or the gold filling. The general public expect graduate dentists to do well what they undertake to do, but, in the matter of general anæsthetics, the dental surgeon must learn, if at all, on his own patients in his own office. You can not become a competent anæsthetist by simply looking on. You must take the inhaler in your own hand; feel the responsibility of the patient's life; test the pulse for yourself; watch the breathing and study the pupillary movements. Not knowing the anæsthetic stages, the tyro becomes alarmed at harmless symptoms, entirely overlooking the quiet danger signals. He is inclined to operate too soon or too long, and thus makes a failure, bringing into disrepute some worthy appliance, and condemns anæsthetics for dental purposes, simply because he is ignorant of both the principles and practice of anæsthetics.

In January, 1905, I stepped into the office of a dental acquaintance in a Colorado city, and found him engaged in a boisterous conversation with a young man, threatening to throw him out of the window if

he did not leave the room instantly. I was astonished at the temper exhibited and the language used by this usually mild Christian gentleman. Inquiry brought out the cause of the disturbance. I learned that the young man who made his exit so hurriedly on my entrance to the office was an agent demonstrating one of the newer anæsthetics. Upon assuring the dentist that the anæsthetic in question was pleasant to take, harmless to a certainty, profound enough in its action to prevent pain, and was followed by no unpleasant results, he was permitted to administer it to a patient belonging to one of the wealthiest and most aristocratic families of the town—one of the doctor's choicest patients. The dentist proceeded to operate when assured it was the proper time. The patient was only partially anæsthetized. A scene occurred such as only those who have witnessed the like can appreciate. Learning the hotel at which the young man was registered, I called on him and asked him the history of the occurrence. He said this: "I am not a dentist—only a dental salesman. My house compels me to go from office to office and demonstrate this anæsthetic. I have no right to administer an anæsthetic, and, if a death should occur, I know that I will be sent to the penitentiary. I am deadly afraid of the stuff, and, rather than make a mistake and give too much, I had the doctor operate too soon, with the result you witnessed." Are you surprised that dentists make failures and are unable to get satisfactory results, when all that many of them know about the subject is what they see at an occasional clinic or learn from some

salesman demonstrator, whose sum total of knowledge of anæsthetics, their action and danger, is usually no greater than that of the man mentioned?

Dental colleges are strict in their requirements in regard to all other studies in their curriculum, requiring so many points in gold fillings, so many in amalgam, so many in crown and bridge work, the requisite number in orthodontia, etc., but, when it comes to anæsthetics, the only study in the course in which the life of the patient is involved, they are satisfied to have some one make an occasional demonstration, the students looking on. A Chicago dentist in the American Dental Journal for October, 1906, has this to say: "Why do some dentists have trouble in administering anæsthetics? Because students are graduated from our schools with the theory only and not the practical experience. A few days ago I had occasion to meet one of the graduates of 1906 from one of the schools in this city. I asked him what experience he had in administering anæsthetics during his college course. He said that he had the best of theory, but scarcely any experience. 'How many times did you administer or assist the demonstrator with chloroform, ether or nitrous oxid, or how many times did you see these anæsthetics administered?' He said: 'I never assisted or saw these anæsthetics started.' I asked him if there had been any operations performed under anæsthetics. He said: 'Yes, but in all the operations that I witnessed the patient was anæsthetized before being brought into the pit.' 'How many administrations was each student required to give with the assist-

ance of the demonstrator?' 'A student was not allowed to administer an anæsthetic; it was always done by a demonstrator.'"

Such carelessness, almost criminal, is equalled only by our medical schools. Even in our best hospitals, internes, selected from the class just graduated, become anæsthetists over night, and assume entire charge of the anæsthetic work. It is a burning shame that every hospital has not a professional anæsthetist, so that this work may not be left to inexperienced men.

Anæsthetics in themselves are not so dangerous as the fact that medical men are turned loose on the public without practical experience in administering anæsthetics, and dental graduates administer anæsthetics without even as much experience as our medical brothers. Notwithstanding this condition of affairs, the percentage of deaths during anæsthesia is not high, and I will show in a later lecture that a number of cases have been included for which the anæsthetic was in no way responsible.

Some months ago I had a difficult third molar operation at one of the Iowa hospitals. The patient took the anæsthetic badly; indeed, at no stage of the operation did the anæsthetist succeed in producing a profound anæsthesia—it seemed impossible even to obtain that depth of anæsthesia which insures safety and comfortable operating. In all twenty-four ounces of ether were inhaled and wasted. A surgeon in an adjoining room in less time performed a hysterectomy, dressed and left the hospital. About a month later I went to a medical college in the same town to give a

clinic and met there a young man whose face was very familiar, but I could not place him. I inquired, "Where have I met you?" He replied, "I am the man who administered ether for you at the hospital not long ago. The interne was away on his vacation and I was taking his place." This man was a junior medical student. One's blood boils with indignation when subjected to such imposition.

The interne question is an important one. The interne is a valuable adjunct to the hospital, but there should be a professional anæsthetist at every hospital, whose duty it should be to carefully diagnose all anæsthetic cases in advance of the operation and determine the anæsthetic to be employed. The interne should work under and in conjunction with the chief anæsthetist and not have the entire responsibility of the anæsthetic cases. The service of an interne is from six months to two years; they are constantly changing; new men take up the work and with it the anæsthetic responsibility.

Many lives have been sacrificed during anæsthesia because the anæsthetist became so absorbed in the operation as to neglect the patient. The tendency and the temptation always is to watch the operation, and, for this reason, the anæsthetic specialist or the professional anæsthetist who has no intention of becoming a surgeon or an operator renders superior service.

Women make the best anæsthetists. They naturally shrink from operative procedure, care nothing about it, and bestow their undivided attention on the patient. There is no place in the world where they

get such wonderful anæsthetic results as at the Mayo Clinic, Rochester, Minn., and the anæsthetists are all women. Alice Magaw, the most successful anæsthetist I have ever known, reigns supreme at Rochester. To say that she has a record of more than 18,000 ether anæsthesias without an accident in 1908 does not tell the whole story. She is masterful in handling patients, and with an amount of anæsthetic that hardly sounds reasonable, in so brief a time, you would hardly believe the statement, tactfully, skilfully induces anæsthesia.

It is claimed that the instruction in general anæsthetics in dental colleges is meagre and not practical; the same may be said of the medical schools. Unless the medical student is so situated that he can take a post-graduate hospital course, or become an interne, not one in ten ever administers an anæsthetic until after graduation and entering practice. It is probably true that anæsthetics receive less attention, in both medical and dental colleges, than any other subject in the curriculum, and this is so, not only in this country, but abroad, as the following quotation from the **British Medical Journal** will show: Dudley W. Buxton, the renowned English authority on anæsthetics, says, "At present there is no uniform teaching on anæsthetics." He suggests that a resolution be passed by the general medical council compelling all medical students, before applying for final examination, to offer evidence of having attended the practice of some recognized anæsthetist. He should also offer proof of having administered nitrous oxid, ether and chloroform." Galloway

calls attention to the common carelessness in regard to the use of anæsthetics. He claims that if unnecessary deaths occur from anæsthetics the responsibility extends beyond the anæsthetizer and includes the medical college which ignores its importance, makes no effort to teach it properly, if at all, and then confers a diploma which the public accepts as the evidence of a training which the student really has not received. The criticism is just, that the dental colleges are not devoting as much time to practical anæsthesia as they should, and the same criticism is equally just that medical schools are almost criminally negligent in their carelessness about anæsthetics.

I am confident that if medical schools demanded as thorough a course of practical training in anæsthetics as they do in the dissecting-room in anatomy, in their laboratories in histology, pathology, and chemistry, and if dental colleges would insist on an anæsthetic technic as they have done in operative and prosthetic dentistry and orthodontia, the percentage of deaths could be reduced fifty per cent. in ten years' time.

Length of Duration of Anæsthesia.

Other things being equal, a brief anæsthesia is safer than a prolonged anæsthesia. The anæsthetist feels less anxiety when an anæsthesia of ten minutes is to be induced than when it is necessary to obtain an anæsthesia of two hours or more for the same patient. The dental surgeon is fortunate in that nearly all the operations he is called upon to perform are of brief

duration, and a general anæsthetic, properly selected and administered, would be less harmful to the patient than the effect of the pain on the nervous system without an anæsthetic.

With the exception of badly impacted third molars, antrum cases, cleft palate, resection of a nerve for neuralgia, necrotic conditions, and tumor formations, all of which really belong to the oral surgeon, **the dental surgeon seldom needs a profound anæsthesia of more than five minutes' duration for any operation that he is called upon to perform.**

If it be true that chloroform is a protoplasmic poison, and ether a nephritic irritant, the brevity of anæsthesia for dental operations would eliminate the probability of harm from these conditions, because deleterious effects would result only from a prolonged anæsthesia.

While brief anæsthesia is not synonymous with brief induction, it does imply brief elimination. The quicker the elimination of a general anæsthetic from the system, the speedier the return of all functions to the normal. If brief elimination is to be desired, brief induction is equally to be desired, and we approach the ideal anæsthetic. In other words, **the patient should be in the anæsthetic state the least possible length of time for successful performance of the operation in question,** and the quicker the induction, and quicker the elimination, the better for all parties concerned; provided, of course, the anæsthetic agent is a safe one. Herein lies the safety and advantage of nitrous oxid and somnoform. You can creep up, as it

were, on the brain and nervous system, anæsthetize them, operate, and the patient return to consciousness, almost before the central nervous system realizes that an anæsthetic has been employed. Such operations as I have outlined in the second lecture can be performed under the influence of nitrous oxid and oxygen or somnoform, the anæsthesia gently maintained, not so deep as for extraction of teeth, but only to the stage of unconsciousness. The obtundent or analgesic stage is sufficient to allay all fear on the part of the patient and prevents that worn-out, all-gone feeling of exhaustion and fatigue during and subsequent to dental operations.

LECTURE V.

Shock.

The fourth classification under Elements of Danger is that condition which causes more deaths during anæsthesia than all other accidents combined, namely, **shock.** By shock, we mean depression. **We have depression of respiration, or respiratory shock; depression of the circulation, or circulatory shock.** Hewitt goes further and adds what he calls **composite shock; i. e., respiratory shock rapidly followed by circulatory depression, or circulatory shock rapidly followed by respiratory depression.**

It is difficult to formulate an intelligent, scientific definition of shock. Nearly every writer on this subject has a definition of his own, which definition does not meet the approval of any other writer; hence, there are a multitude of definitions, but a lack of unanimity of thought, which is confusing and unsatisfactory. Taking into consideration the causes of shock and combining these with the manifestations of shock, the condition is defined. **A patient in a condition of shock is quiet; the mucous membrane is pale; the temperature frequently below normal; the pulse rapid, but weak; the blood pressure low; the cutaneous reflexes diminished or abolished; respiration shallow; skin cold and**

clammy; increased respiration; increased perspiration; the action of the mind slow or dazed; neither delirium or hysteria is present; no nervousness; pupil somewhat dilated and responds feebly to light. These are the conditions we find present in shock to a less or greater degree.

Now as to the causes of shock. The causes are numerous, but they act in each case by stimulating the afferent nerves, and, if these nerves are stimulated too suddenly, too frequently, too painfully, too forcibly, or in a too prolonged degree, shock supervenes.

Shock, then, may be defined as a condition of depression, produced by exhaustion of the medullary centers controlling respiration and circulation, by a too sudden, too frequent, too painful, too forcible or too prolonged stimulation of the afferent nerves, "the essential phenomenon being a diminution of the blood pressure."

For the sake of convenience, we may classify patients suffering from shock into two groups:

First: Psychical, those affected by mental impressions.
Second: Physical, those in which shock is dependent upon too sudden, too frequent, too painful, too forcible, or too prolonged stimulation of the afferent nerves.

In the first group, the psychical, those who are affected by mental impressions, fear is the etiological factor to be dealt with—fear or dread of the operation; fear or dread of the anæsthetic, if one is suggested.

The dental surgeon meets and must combat this condition daily. Not long ago, a patient to whom I had just administered an anæsthetic for tooth extraction told me that on a former occasion, while sitting in a dentist's chair, the dread of having used a local anæsthetic was so terrifying, that before the dentist had time to make the injection, she fainted and for two hours was in a most critical condition. It was only the assurance that I could operate absolutely painlessly, that gave her sufficient confidence to take the anæsthetic.

Dr. McClanahan, of Iowa Falls, Iowa, told me that he had a similar experience, except that he was to make an examination of the teeth, not to extract. He turned to his instrument case a moment, and, upon resuming his position at the chair, his patient was pale, gasping for breath, had lost consciousness, and it was three hours, assisted by physicians, before she was resuscitated.

While writing the above sentence, the postman brought the mail, leaving a sample copy of **D. D. S.** **for** September-October, 1907. The first article is entitled

"Death From Shock.

"Since our last issue a Dayton dentist has had one of those experiences that are so trying to the members of our profession—namely, a death in his chair while engaged in performing his regular duties.

"A young woman applied to him for the extraction of a tooth. There was nothing about her condition

that would indicate that she was not in average health, and the dentist prepared to relieve her of the offending member.

"There were reasons that seemed entirely satisfactory to him why a general anæsthetic need not be given, though he is expert in the use of somnoform, neither was he prompted to inject the tissues with a local anæsthetic. Instead of these he saturated a pledget of cotton with an anodyne, applied it over the gum, then proceeded with the extraction. The tooth was a lower bicuspid and showed no unusual difficulty in removal.

"No sooner had it been lifted from its socket than the woman's body was noticed to relax, her head fell forward upon her chest, and her breathing ceased. Examination disclosed a pulseless wrist.

"In the next room was a physician who was immediately summoned. * * * * * * *

"They did everything that a competent physician and skilled dentist could do without accomplishing anything.

"You ask the cause? It was shock. The dread and fright of the extraction started an impulse that probably contracted the circulatory vessels of the vasomotor centers in the medulla which in turn so greatly interfered with the action of the pneumogastric nerve that the heart and lungs ceased to act. * * * *"

A man went to a hospital in England to visit his father who was mortally ill. After leaving the hospital, he dropped dead a hundred yards from the gate from mental emotion. There was a post-mortem of both

next day, the father dying from disease in the hospital, the son from shock at the hospital gate. (Brunton.)

A patient was being anæsthetized for an abdominal operation. The surgeon, standing with his knife in hand, awaiting the signal to operate, with the point of the handle traced the place and length of incision he would make—the patient died immediately. Sufficiently anæsthetized to be rendered helpless, yet convinced that the surgeon was beginning the operation, shock resulted, and the patient died. This was recorded, of course, as a death from anæsthesia. Dr. Schofield, in his recent work on "The Subconscious Mind," relates a case which occurred in England. A man was condemned to the death penalty; his head was on the block awaiting the fall of the axe, when he was reprieved; but he was found to be already dead from shock.

The French surgeons report this case: A patient was to be operated upon, and his condition contra-indicated the administration of general anæsthetics; but he demanded chloroform, and, to calm him, the surgeon held a cloth without chloroform before his face. The patient had taken but four inhalations of air, when he died.

A gentleman was sitting in the chair of a Parisian dentist, mouth-prop inserted, ready to have administered nitrous oxid. The operator, the inhaler in hand, turned aside to signal the assistant to turn on the nitrous oxid; resuming his position at the chair to make the administration, found the patient dead. Had

this patient taken even one inhalation of the gas, it would have been recorded as a nitrous oxid gas death.

Just recently at Ackley, Iowa, a horse was tied to a post near a railroad track. An engine came thundering along at a rapid speed, and, when opposite the horse, the whistle gave a tremendous shriek. The horse reared, plunged forward and fell dead from fright—**shock.**

In the second, the physical, we classify those cases of shock which are dependent upon too sudden, too frequent, too painful, too forcible, or too prolonged stimulation of the afferent nerves. While the psychical equation is also present in this second group, and in many cases cannot be eliminated, yet it is the more tangible causes of shock, those which may be denominated exciting causes, that will be taken into consideration. **The etiological factor in this group is some physical irritant.**

In reporting mortalities resulting from chloroform anæsthesia, it is frequently said that the patient died after the first two or three inhalations. Some of these deaths are the result of mental impressions, **fear**; others from direct irritation of the sensory nerves of the nares, pharynx, bronchi or lungs. Some writers are of the opinion that nearly all of the chloroform mortalities that occur from just a few inhalations of the anæsthetic are purely psychic. If this were true, deaths would more frequently occur at the very beginning of the administration of other anæsthetics. We know that a handkerchief on which has been placed chloroform, and even aqua ammonia, held under the nose of a rab-

bit, will cause its heart to cease beating. The wonder is there are not many more chloroform mortalities when we take into consideration the careless manner in which chloroform is administered. It only takes two per cent. of chloroform vapor to anæsthetize a patient and one per cent. is sufficient to maintain anæsthesia, but this is either not well understood or is not believed, because during an average anæsthesia, many, many times this amount of chloroform is usually employed. All those deaths, that occur during the first minute or two of chloroform anæsthesia are the result of shock, either from the first cause assigned, fear, or the second, by too suddenly irritating the afferent nerves.

If chloroform is administered in a very dilute form, and gently, we get no shock in either plants or animals, as Sir James Y. Simpson has demonstrated. He made some very interesting experiments on that most delicate of all plants, the sensitive plant, the *mimosa pudica.* If you touch the leaves of the sensitive plant, they at once fold up and fall down upon the stock. Sir James, who discovered the anæsthetic properties of chloroform, found that if you subject this plant to the strong vapor of chloroform, the leaves would close up just as if you had irritated them in any other way. But if you apply a very dilute chloroform vapor, you can now handle the sensitive plant and it does not irritate or cause it to fold up. In other words, it has been anæsthetized by the mild vapor without irritation, while the strong vapor produced shock and defeated anæsthetization. The mild vapor does not produce any

irritation whatever, simply produces anæsthesia. The same is true of the rabbit and the guinea-pig—diluted chloroform vapor produces anæsthesia without irritation, but, if a strong vapor is used suddenly, it will irritate the vagus reflexly through the fifth nerve and the respiration will cease; what is true of plants and animals holds good in that higher animal, man.

The irritating general anæsthetics, then, should be administered in dilute form, starting with just a trace of vapor, and gradually increasing the strength as the nerves along the respiratory channel become accustomed to the anæsthetic, or are themselves locally anæsthetized.

There is a form of shock that results from blows or external pressure. A blow suddenly delivered upon the abdomen or about the heart sometimes produces death from nervous shock affecting the solar plexus. If I remember correctly, it was a blow received in the stomach of Corbett, delivered by Bob Fitzsimmons, that "knocked him out"; a little harder blow would have completely paralyzed the solar plexus and ended the life of Mr. Corbett.

Before the introduction of general anæsthetics, the methods used to induce anæsthesia were peculiar and almost ludicrous. One method was for three strong men to stand on each side of the patient, who was placed in the recumbent position, and at a given signal the patient was raised quickly to the standing position. The head was raised quicker than the blood could follow it, and this temporary anæmia of the brain brought about a faint, during the continuance of which the

operation was performed. It was proposed by the late physiologist, Dr. Waller, to produce anæsthesia not by simply raising the man, but by garrotting him, simply putting the finger and thumb upon the carotid arteries, compressing them suddenly, and thus rendering the patient insensible; but the introduction of anæsthetics prevented either of these plans from having a very wide use. (Brunton.) This sudden compression of the carotids to produce insensibility is one of the jiu jitsu tricks of the Japanese. A person is rendered immediately insensible by shock, and, if the force be applied too vigorously, the patient does not revive.

Most persons killed by hanging or strangling die from shock, not suffocation. A sudden pressure on the larynx and trachea causes reflexly, through the nervous system, a sudden stoppage of the heart and lungs. It is not that the respiration ceases and the heart continues its action, as in suffocation, but the heart and lungs both cease to perform their functions. It is said that more than half of the people who die from falling into water are not drowned; they do not die from suffocation, but from shock. (Brunton.) They are either frightened to death, or the sudden shock of falling into cold water acts reflexly, and both respiration and circulation are discontinued.

External pressure plays such an important part in the production of shock that every possible precaution should be taken in administering anæsthetics to prevent the slightest pressure on the throat, lungs, chest or abdomen. The position of the patient has much to do with the pressure on the parts mentioned. A pa-

tient, who, in the standing position, thinks her corset quite loose, upon taking her seat in the dental chair, through readjustment of the abdominal organs, finds the corset very tight, and the fatter the patient the more she spreads out in the sitting posture. There is only one safe method of procedure; that is, **refuse absolutely to anæsthetize any woman unless the corset is removed no matter what anæsthetic is employed.**

The same is true, in a lesser degree, of all bands and collars, loose enough, perhaps, in the upright position, but the patient under anæsthesia may slide into a position that will render the collar and band extremely tight without the anæsthetist observing it. Even should no dangerous symptoms arise from operating without removing the corset and collar, I am satisfied that most of the nausea occurring in dental chairs during or as the result of administering nitrous oxid and somnoform is the result of tight clothing. **No woman is as easily and as successfully anæsthetized in tight clothing as in loose clothing,** and most of the failures to successfully and comfortably anæsthetize patients is the result of carelessness or ignorance, on the part of the dental surgeon, in regard to properly arranging the patient for the operation. If it should become necessary to resort to resuscitory measures, the corset is always in the way, and the patient might die before you could free the muscles of respiration or massage the muscles about the heart.

Spasm of the glottis is the condition to which I will next call your attention. Bear in mind that spasm of the glottis may arise at the very beginning of the

administration of an anæsthetic, through carelessness, if the vapor be too strong; and at the conclusion of the anæsthetic, from the accumulation of blood, mucus, vomit, etc., in the larynx. Spasm of the glottis is the condition that gives me the most anxiety in my anæsthetic work. It is the condition that I ever bear in mind in administering anæsthetics, the condition for which I watch most closely and constantly. As I have previously said, this condition may arise at the beginning of anæsthesia, and in operations in the mouth, nose and pharynx, at the close of or during the operation. When it occurs at the beginning of anæsthesia, it usually arises from too suddenly or too powerfully stimulating the sensory nerves along the respiratory tract. The cases we have just been considering, those in which patients died after taking but two or three inhalations of the anæsthetic, were deaths from spasm of the glottis. The remedy has already been suggested: begin the anæsthesia with a very dilute anæsthetic-laden vapor, the patient taking normal inhalations in the beginning. If you will bear in mind constantly what I have said about always beginning with a dilute, non-irritating vapor, you will probably never see a case of spasm of the glottis in the first stages of anæsthesia. Spasm of the glottis occurring after beginning to operate, or at the close of the operation, is a very different matter. I watch for this condition more earnestly, if possible, than that form of spasm of the glottis which results from faulty anæsthesia.

We will next discuss spasm of the glottis occurring

during or at the close of the operation, the exciting cause being irritation of the nares, pharynx, larynx, or trachea, the result of blood, mucus, saliva, vomit, or other foreign matter collecting in the throat. I have stated previously that **the one condition I watched for most carefully, and the one that caused me the most anxiety in my anæsthetic work was the passage into and a collection of blood in the throat, lest from pressure or interruption of respiration the vagus be irritated sympathetically and shock result. One of the brightest young dental surgeons Iowa ever produced met his death from shock, the result of blood collecting in the throat following a tonsilotomy.**

As long as the patient swallows freely, there is nothing to dread; but at that stage, when, with some patients, there is contraction of all the muscles of the body and a stiffening and hardening of the throat muscles, a serious condition may arise. In this condition, the patient can neither spit nor swallow, and it is important that blood be prevented from entering the throat. Methods of preventing blood accumulating in the throat are fully described in the lecture on "Elements of Success."

Eliminating spasm of the glottis, **blood should be prevented from entering the stomach, because it nearly always causes nausea.** If patients are not nauseated in the office, they are apt to be nauseated after going home, and the anæsthetic is usually blamed or condemned. Care must be taken to prevent teeth or roots of teeth from entering the throat, especially the larynx. Teeth have been known to pass into the pharynx, enter

the trachea and produce spasm of the glottis, making tracheotomy necessary.

Even with nitrous oxid and somnoform, when possible, have your patients eat only moderately, or not at all, prior to anæsthesia. Three hours after eating a meal is a convenient time to administer these anæsthetics. Although I anæsthetize patients any hour that they happen to come with nitrous oxid or somnoform, if I have the privilege of making an appointment, I select the hours of eleven o'clock in the morning and between three and four o'clock in the afternoon. Although nausea rarely occurs with these anæsthetics and is not apt to happen, yet **we should take every precaution to prevent it.** Should nausea occur while the patient is anæsthetized, there is risk of undigested food, from its presence and position, causing spasm of the glottis. This matter was forcibly brought to my attention on an occasion when I was administering nitrous oxid at my clinic, before a large class of students at the College of Dentistry, State University of Iowa. The inhaler which I was accustomed to use at this clinic refused to work; as a substitute, an old hard-rubber tube which passed into the mouth was resurrected, the rubber hood falling around the nose and face. With this hard rubber tube in the mouth, about an inch in diameter, it did not occur to me that a mouth-prop was necessary. I proceeded to administer nitrous oxid, and when satisfied that the patient was sufficiently anæsthetized for the operation, removed the inhaler and the patient's mouth closed with the speed and force of an old-time muskrat trap. Imme-

diately he became nauseated, and the contents of his stomach, undigested food, filled his nose, mouth, and pharynx. His face became purple, then black; he ceased to breathe. It was impossible at first to force his jaws apart. We bounced him up and down in the chair, hoping to force back the undigested food. Fortunately, two front teeth were missing. I inserted my finder, assistants keeping up the bouncing, and some air must have entered his lungs, for at this stage of the resuscitation, he opened his mouth and discharged the contents of his stomach. It was the first and only alarming condition I have ever witnessed in my anæsthetic work. This experience was worth more to me and to the class than a hundred cases in which the result was perfect. I was at fault, first, in that I did not use a stable mouth-prop; second, in that I did not inquire how long it had been since the patient had eaten his last meal. The hour of dinner is so universally noon in this State, and, as the clinic was arranged purposely between the hours of three and four, I did not make the usual inquiry. The patient informed me afterwards that he had only finished his dinner a few minutes before coming to the clinic. We came very nearly having a fatality, and the fault was all my own. Had this young man died, his death would have been recorded as a nitrous oxid death. Had the mouth-prop been in position, he would simply have lost his dinner, and the case forgotten long ago.

When ether and chloroform are the anæsthetics employed, every preliminary precaution known should be taken to prevent nausea. This matter of preventing

nausea as the result of ether and chloroform anæsthesia and its treatment will be considered in another lecture.

Another cause of shock is operating in the preliminary stages when anæsthesia is being induced, or in the later stage when it is passing off. If you will investigate the matter ascertaining at what time during anæsthesia deaths occur, you will discover nearly all the fatalities happen during partial anæsthesia, that very seldom is a mortality reported during profound anæsthesia.

Lauder Brunton speaks of having witnessed only one death under anæsthetics. It was a man who was having the supra-maxillary bone removed for malignant disease, and the whole of the orbit was exposed. On account of the risk of blood running down into the trachea and choking him during anæsthesia, he only had a few drops of chloroform at the beginning of the operation, just enough to allow the preliminary incision to be made. The rest of the operation was conducted without any anæsthetic, and the man died on the table from the shock of the operation.

It is important, even in the matter of extracting teeth, that the patient be sufficiently anæsthetized before beginning to operate. Do not begin to operate until you are satisfied that pain will not be felt, and be sure to stop extracting before the patient is sufficiently awake to feel pain. In my early professional experience, I had great difficulty in making physicians understand this when administering anæsthetics for me for the extraction of teeth. As soon as the patient

was rendered helpless, they would insist on me beginning to operate, and near the conclusion of the operation, they would say, the patient struggling and screaming, "Go ahead, I will hold her hands and she won't remember it when she comes out." This is always a dangerous procedure, and should not be sanctioned by the dentist or allowed in the dental office. In the year 1906, thirty chloroform deaths occurred in dental chairs. The deaths from chloroform in dental chairs is larger than the percentage of deaths from chloroform in the office of the physician, the home of patients, or in hospitals. It is well to bear in mind that some patients are more susceptible to the influence of anæsthetics than others. Patients have idiosyncrasies in regard to anæsthetics, the same as with other drugs. On one occasion, a patient returned to my office with a pericemental inflammation, the result of an immediate root filling. My iodine and creosote bottle accidentally fell from my hand, struck the iron base of the chair and broke. In this predicament I saturated a small pellet of cotton with chloroform and applied it to the gum as I would have applied the iodine and creosote solution. That amount of chloroform was in this case sufficient to produce sleep of five minutes duration. Having discovered that this patient was so susceptible to chloroform, on several subsequent occasions, with the amount of chloroform indicated, I prepared a number of sensitive cavities for fillings. Had it been necessary for this young woman to take chloroform for a surgical operation, being so susceptible to its influence,

the quantity usually administered in the beginning by most anæsthetists might have produced shock.

It is important, then, in the very beginning of anæsthesia, with all irritating anæsthetic agents, that the narcotic-laden vapor should be administered in a very dilute form.

LECTURE VI.

Dental Fatigue.

We have said that shock is exhaustion of the medullary centers, the result of irritating the sensory (afferent) nerves; this condition, in a milder degree, constitutes fatigue. Shock is dependent upon too sudden, too frequent, too painful, too forcible, or too prolonged stimulation of the afferent nerves; the same is true of fatigue. Dental fatigue and dental shock, then, differ only in degree. Surgical shock is a dangerous condition and the general surgeon uses every precaution to prevent it. Dental fatigue bordering on shock must be handled with the greatest of care by the dental surgeon to avert shock.

Every dental surgeon has and every dental surgeon will continue to have his quota of those nervous, high-strung patients, many of whom suffer with pain days, weeks, and even months before they can nerve themselves to the ordeal of visiting the dentist. Many of them will tell you afterwards that they got as far as the office door two or three times and returned home again. I recall a case just now of a young woman who told me she had walked to my office on three successive days a distance of seven miles, through the snow, with the thermometer twenty degrees below

zero, for the purpose of having a tooth extracted. Each time the tooth stopped aching when she started up the steps, and not till the third trip could she muster up sufficient courage to enter the office. Such patients are to be pitied, because their mental suffering far exceeds the severest pain that could possibly be inflicted. Recently a patient said to me, as she sat in my chair ready to be anæsthetized, pale and trembling with fear (not afraid of the anæsthetic, but afraid she would be hurt in spite of the anæsthetic): "Doctor, give me enough please, so I will not feel the pain; I had rather never wake up than to have you hurt me." An anæsthetic for this patient was her only salvation. It would have been dangerous to have extracted for this patient without an anæsthetic. The mind has a powerful influence over the body—positively, constructively, by enabling it to overcome obstacles; and negatively, destructively, by acting adversely on the body.

Such patients must be handled with the greatest of care. At the first sitting, with this class of patients, if only an examination is to be made or soft decay removed to make a treatment for pulpitis, the face becomes pale, respiration impaired, circulation off, the skin moist, and, if too sudden, too painful, or too prolonged irritation be made, the centers governing respiration and circulation are exhausted, fatigue supervenes, and shock follows. In other words, too great a demand on nerve centers exhausts them, and they refuse to act. This state is present under other forms of stimuli, such as occur in the painful preparation of cavities, removing pulps of teeth, polishing fillings,

and the many forms of nerve-racking processes which make up the daily operations of the dental surgeon. Often the class of patients who seem to be bearing the irritation of dental operations well will tell you to go ahead and finish what you are doing, but all at once they turn pale, perspiration breaks out on their faces, and they, in spite of their marvelous force of will, are exhausted. This is what I mean by dental fatigue. In this condition, we have exhausted the reserves of the patient; we have brought about a panic, more or less serious.

The general surgeon employs anæsthetics to prevent shock; **the dental surgeon should employ anæsthetics to prevent fatigue and avert shock.** A small amount of nitrous oxid, ethyl chloride, somnoform, or chloroform will soothe the fibrille of the nerves so that they will not send so frequent or so strenuous calls to the brain. We have an illustration of this in patients who have embraced Christian Science. They have practiced that form of nerve inhibition which their belief calls for, till the end organs no longer telegraph the pain sensations to the upper levels of the brain, in which is located the seat of consciousness. Anæsthetics accomplish the same result by numbing those in-carrying nerves of sensation so that they do not vibrate to peripheral stimuli. The Christian Scientist has learned to do the same thing that the auto-hypnotist has learned to do; overcome or prevent pain by nerve inhibition. I resided for a while in a little town in eastern Iowa. Among my patients was a Mrs. P—. Mrs. P—'s teeth were very sensitive. All I could ac-

complish or hope to accomplish for Mrs. P— was to secure dryness of cavity sufficient to retain cement for a while. No attempt at cavity preparation was ever made. We both congratulated ourselves if we could succeed in protecting the teeth from the irritants of the mouth. Such dentistry afforded only temporary relief, and Mrs. P— was my most constant and persistent patient. I moved from the town of A— to one of our larger cities, C—. One day three years later, a patient opened the office door and walked in; it was Mrs. P—. That feeling of fatigue we are now discussing came over me—that dizzy, fainting, all-gone feeling. I had hoped that I would never have to operate for Mrs. P— again, and I argued with myself what course to pursue as I continued with my patient before greeting her. I approached her and said: "Good morning, what can I do for you?" She replied: "You do not remember me, do you?" I said: "Yes, I do; you are Mrs. P— of A—." "My teeth have all gone to pieces since you left A—, and I want an appointment, for we are living here now, and I can come at any time and as often as you wish me." I sat down by her side and said: "Mrs. P—, you know that your teeth are so sensitive that I can not operate for you properly. There are a number of excellent dentists in C— and I prefer that you have your work done by some other operator." She made reply: "I will not do anything of the kind. I am a Christian Scientist now, and it will not hurt me one bit to have my teeth filled." I told her if that was the case of course it would not hurt her, and gave her an appoint-

ment. Christian Science was new then, and this was my first opportunity to operate for a Christian Scientist.

I was expecting the same condition of affairs in a modified degree. I looked for some improvement in the matter of self-control, but it never occurred to me that she would prove other than a most exasperating patient. The morning of the appointment arrived; so did Mrs. P—. All of her anterior teeth were carious gingivally, the cavities extending some distance under the gum margin. There were approximal and occlusal cavities also in the anterior and posterior teeth, but it occurred to me that these cavities along the gum margins would afford a good test, and, if I succeeded fairly well here, there would be no doubt about making satisfactory fillings in all of her teeth.

I started to make a cocaine application to numb the gum in order to more comfortably adjust the rubber dam. She promptly informed me that she did not wish any drugs used; it was not necessary in her case. I adjusted the dam, forced the gum back out of the way, my assistant holding it by means of a ligature. I not only prepared one cavity that morning, but three, and filled them with gold, and Mrs. P— never so much as wrinkled her forehead. I made fillings wherever they were indicated, and she would leave the chair after two or three hours' sittings without apparently the least fatigue or exhaustion. The first superior bicuspid on each side had gradually crumbled away till the roots were completely hidden. These Mrs. P— wished removed. I dissected back the

gum of the one on the right side, located the edges of the root, and with my thinnest blade forceps, pushed with all my might; the bone spread and the root popped out. When I showed it to her she said: 'Is that all there is to having a root out." I pushed up around the other root without dissecting the gum, and it nipped off two or three times, but, with the exception of her face getting red in the malar region, there was nothing to show that she was the least disturbed physically or mentally by this operation. "Great God!" I said to myself, "this woman is the same only in name as the Mrs. P— I used to work for in the town of A—."

The Christian Science movement spread rapidly in that community. A church was organized and they rented a room across the hall from my office in which to hold their meetings, and they must have appointed me their official dentist, for they came to me in numbers for their dentistry. Mrs. P— became a healer, and would bring me patients and remain with them and treat them as I operated, and another healer, a Mrs. L—, would do the same thing. The effect was marvelous. Once in a while, some of my old patients would return for work, having in the meantime embraced Christian Science, and I had opportunities to observe the effect in numerous cases. They were not all like Mrs. P—. Some admitted being hurt; some would request me to wait a moment, now and then; but all of them maintained a marvelous control over themselves, many complaining of no pain, others denying that they experienced pain.

Some people, by constant practice, have acquired the habit of moving their scalp backwards and forwards; others to wriggle their ears like a mule; while others with equal celerity have learned to throw their cerebral hemispheres out of gear, to exercise the power of inhibition and shut off pain from certain parts of the body, much the same as the electric lights in one room of a house can be extinguished at pleasure, by turning a switch, while the lights burn brilliantly in all other rooms of the house.

"You will find recorded in Fox's 'Book of Martyrs' some very curious statements regarding the condition of people who were tortured by the Inquisition. It is said that some of them not only felt no pain, but felt positive pleasure, so that they regretted being removed from the rack, which seemed to them a bed of roses." (Brunton.)

We can not instruct our patients how to use autohypnotism, or in all cases overpower them with suggestion, or teach them the art of inhibiting pain by throwing their cerebral hemispheres out of gear, but I will instruct you how to obtain the same results, artifically, by the use of nitrous oxid, ethyl chloride, somnoform and chloroform vapor.

Hypnotism is the ideal anæsthetic, the anæsthetic **par excellent**; but the dental profession is not ready for this yet. What they are waiting for I do not know. But the dentists are waiting, holding back, I suppose, just as they have delayed availing themselves of the use of general anæsthetics for dental operations, till

the general public demands and compels them to adopt their use.

Some twenty years ago, Dr. Chas. Davis of Chicago, surgeon in charge of the Temperance Hospital, hypnotized a patient for me, and, in this hypnotic state lasting about forty-five minutes, Dr. W. E. Hodgin and myself prepared and filled a cavity with gold in the upper left central incisor. This patient did not know that he was to have a tooth filled. The tooth was a difficult one over which to adjust the rubber dam, and we had Dr. Davis make the suggestion, "dry mouth," and there was no moisture present, and cotton rolls were used to hold the lip out of the way. Further, he was commanded to hold his mouth open, and this he did throughout the entire operation. Dr. Davis was in an adjoining room and did not return till we had the filling completed. The doctor aroused him at our request and when we showed him the filling he was very much surprised. Suggestion is used today, in a greater or less degree, by all physicians, and hypnotic clinics have been established in which all diseases are treated under hypnotism.

The psychic causes of dental fatigue can not be eliminated from the direct or physical causes. The psychic causes are always present and augment the physical. The following are the most common physical causes; inflicting pain too suddenly—for instance, thrusting a broach into a pulp which is supposed to be anæsthetized with cocaine but the cocaine has not been absorbed; holding the rapidly rotating bur too long against the sensitive dentine, without lifting it fre-

quently so that both the tooth and bur may have an opportunity to cool; rapid and prolonged grinding with a corundum-stone, whether shaping a tooth for a crown or completing a gold filling with sandpaper strips and discs when the patient's vital force has already been overtaxed; or a combination of two or three of the above causes at the same sitting; extraction of a tooth when the vital forces have been lowered from intense suffering and loss of sleep; prolonged effort to remove a root or roots after the tooth has been fractured; removing too many teeth at a sitting without an anæsthetic. To these might be added too frequent sittings and sittings of too lengthy duration even though the operation may not be painful.

Patients exert themselves to the limit of endurance in the dental chair. If we stop in time, shock or collapse is avoided. We seldom witness an exhibition of fatigue in the dental chair. Patients nerve themselves for the ordeal, store their energies in advance, as it were, as we charge a storage battery. It is at their homes after leaving the office that the penalty is paid.

The remedy in all these cases is to use enough of one of the available anæsthetics to relieve dread and fear. The easiest people to persuade to take an anæesthetic are those that suffer most. They are willing to take or do anything to avoid pain or knowing about what is going on. For operations other than extracting, the analgesic stage is usually all that is necessary. A few inhalations of chloroform, somnoform or nitrous oxid and oxygen usually are sufficient to render oper-

ating comfortable for both the patient and the dentist.

For a description of the methods employed and how to administer nitrous oxid, nitrous oxid and oxygen, ethyl chloride, somnoform, and chloroform to prevent dental fatigue, you are referred to the lectures on these anæsthetic agents, individually.

Case I. Miss A—, a school teacher. Extremely nervous from work in the school-room, presented for removal of pulp in upper right second bicuspid. It was simply impossible to use an engine on this tooth. Mouth-prop adjusted, nitrous oxid and oxygen was used, and pulp removed without discomfort. This patient had been to two dentists that morning, who failed in their efforts to open into the tooth properly for nerve devitalization. This patient left the office stimulated and not exhausted, as on all former occasions, when leaving the dental chair. At subsequent sittings a number of cavities were prepared painlessly for fillings, under nitrous oxid and oxygen analgesia.

Case II. Mr. B—, a robust man about forty years of age. A bridge had been placed in the mouth several years previously. One of the abutments, an upper molar, had not been devitalized. The pulp had died, infecting the tissues above, and it was necessary to remove the bridge. These conditions are usually as painful as the dentist is ever called upon to treat. The slightest touch of the bridge was simply unendurable. Nitrous oxid and oxygen was used in this instance. The crowns were slit, the bridge removed, and the pulp chamber of the molar entered for vent and drainage; time required, about four minutes.

Case III. A case of nerve fatigue and collapse. Mrs. J—, naturally frail, came to me for an extraction, with the following history. She had in her mouth a number of gold fillings beautifully made, the Black cavity preparation being followed precisely. The operator in this case underestimated the vitality of his patient. At the last sitting, she informed me, she collapsed in the chair, was unconscious two or three hours, and for months was confined to the house and could walk now only with the aid of a cane. With a history of this kind and the patient looking more dead than alive, an extraction becomes an important matter. It was dangerous to extract without an anæsthetic; I would not assume that risk. I administered somnoform very gently with the Stark inhaler admitting much air and got along nicely without after trouble.

Case IV. Nausea, the result of nerve irritability. Patient, a healthy young farmer unused to dental operations. Operation, preparation of a cavity in a devitalized lower molar and insertion of a gold inlay. The preparation of the cavity was about all he could stand, and, when the inlay was in position, slight grinding with a corundum-stone and sandpaper discs produced nausea, sick stomach and fainting, and the operation had to be postponed. He remarked that he could stand pain, but the grinding sensation was too much for him. At another sitting the operation was completed under nitrous oxid and oxygen analgesia without nausea.

Case V. Miss C—, age fourteen. Had neglected her teeth on account of dread and fear of the dental

chair. An exposed pulp brought her to the office, but her courage failed. Upon explaining the use of nitrous oxid she readily consented to have it used, and her teeth in due time were all filled, and her mouth placed in a healthy condition.

Case VI. Little boy, about eight years of age. I was summoned to the office of Dr. M—, a dentist, to administer somnoform and found this little fellow waiting. The lower right central incisor was in a state of acute alveolar abscess. I administered somnoform and his dentist, with a new bur in an electric engine, went through the disto-approximal surface into the pulp chamber and the pus oozed out. The administration of the anæsthetic and the operation did not consume more than sixty seconds.

LECTURE VII.

Elements of Success.

Success in administering anæsthetics does not depend entirely on the anæsthetic employed or on the manner in which the anæsthetic is administered. There are a number of small details to which I wish to call your attention, all of which are highly important in order to obtain the best of anæsthetic results.

The anæsthetic room should be the most quiet room in the office. It should also be the most private room. The forceps should at all times be kept out of the sight of the patient. Adjoining the anæsthetic room should be a private room, the rest room or preparatory room. In this room should be a dresser with a large mirror, a sofa or lounge, wash-basin and water, a toilet, if possible, and a large supply of clean towels. This room should at all times be kept neat and clean, being especially careful that no blood-stained napkins or towels be in sight.

Usher the patient first from the reception room into the anæsthetic room, if you are so situated that you can have a room for this exclusive purpose. In this room get the history of the case, make your diagnosis, decide on the operation and know for a certainty exactly what you intend to do, so that you will not have

to make another examination when the patient takes the chair the second time.

Your lady assistant now takes the patient into the preparatory room. The assistant understands that, if a woman, **the corset must be removed, no matter what objections are raised by the patient. The collar should be removed and all bands loosened.** If the patient is daintily dressed and the operation is one in which there will be considerable hemorrhage, have the assistant take off the waist and make a dressing-sack of two towels, as patients frequently put their fingers in their mouths, and, before you can prevent it, will place their hands on their gowns and soil them, a situation to be avoided. **If the bladder has not been recently emptied, the assistant should attend to this before the patient takes the chair.** Right here is the test of your assistant. If she understands her business, she can take the most nervous woman and talk her out of her nervousness. Instruct your assistant to keep up a run of small talk. It will keep the mind of the patient from dwelling on the operation. You can take it for granted that usually the calmest of patients are frightened, terribly frightened, and the assistant must get them over this, if possible, before they get to you. Have her tell the patient there is nothing to dread; say, "Mrs. —— took the anæsthetic yesterday and she was as frightened as you are, and she had a delightful experience." Keep up the conversation, don't give the patient an opportunity to tell how scared she is. She will get worse scared in the telling. Mention a number of pleasing cases, especially some one of their ac-

quaintances, if possible—laugh with them; there is nothing like a laugh to make one feel at ease. If your assistant is what, in the language of the street, is called a "jollier," she will get the patient in a good frame of mind by the time she is prepared for the anæsthetic. I have known patients to go into the dressing-room white with fear, and step out into the operating-room quiet and tranquil from the influence exerted by the assistant.

While the patient is being prepared both physically and mentally by the assistant, there are some things to be attended to in the operating-room. These things I prefer to do myself. I select all instruments that I anticipate using and boil them thoroughly. I then arrange them on a table in the order in which I expect to use them. The table should be protected by a towel and another towel thrown loosely over the instruments, to conceal them from the patient. Make ready the anæsthetic appliance, prepare the hands properly, and when everything is in readiness for the patient, and not until then, signal the assistant to place the patient in the chair. **Not a moment's time should now be lost in attending to anything but the patient.** As soon as the door leading from the rest room is opened by the assistant, begin to augment what she has been saying about the anæsthetic being pleasant. If you are not accustomed to giving anæsthetics, you will possibly be worse scared than your patient. Don't show it. **Act as if giving anæsthetics was the pleasantest thing in life.** Try to make your patient feel that it is a great treat to take an anæsthetic. Reassure the

patient that he will not be hurt—then keep your word. Place the mouth-prop in position, and adjust the inhaler. Right now begins your worst battle with that terrible incubus to the human mind, fear. **Be gentle, kind and watchful, but above all things be masterful.** Remember that your enemy to a successful anæsthesia is this latent, powerful force which is located in one of the deepest levels of the sub-conscious mind. Begin to talk away their fright. Tell them, "You are now going to sleep and will have a quiet rest and wake up when I call you. You need have no fear, for this is sleep, just as you sleep at home in bed. You are not afraid when you go to sleep at home and you are not afraid now. I am watching you and caring for you; nothing can harm you. Give yourself up to this restful sleep. You are now getting sleepy. You are going to sleep." Keep up this talk until you see the symptoms of anæsthesia. You will find it very helpful to the patients as they are passing through those strange doors of artificial sleep. **Suggestion has a large place in my anæsthetic work, and I heartily recommend you to adopt its use. With such suggestions as I have indicated, the amount of anæsthetic required will be reduced to the minimum.**

About five years ago a young man came from a distant town to have extracted the upper third molars. I decided to use somnoform. I had just procured a Stark inhaler and wished to try this very beautiful appliance. The Stark inhaler is so arranged that the amount of anæsthetic required can be accurately obtained. You can admit just the amount of air needed

in each case, or you can exclude all anæsthetic and give the patient a few inhalations of air before you add any anæsthetic. I allowed this patient a few inhalations of air and gave him the verbal suggestions above indicated. After he had taken about six inhalations of air, his arm dropped to his side and he to all appearances was anæsthetized, yet he had at that time breathed only air. I placed the inhaler to my face to see if I could be mistaken. No somnoform was escaping from the inhaler. He was in a state of anæsthesia without inhaling any anæsthetic. To be on the safe side, as I had promised not to hurt him, I gave him two inhalations of somnoform with about half air. I extracted the teeth and waited for him to awaken. He slept for a few minutes, and showed no signs of waking up, so I called to him and told him to wake up. He did so and seemed surprised to find that the teeth were out. I asked him if I had hurt him, and he said that he did not feel a thing. I asked him what it was like. He said: "It seemed to me just like when they hypnotized me." The conversation disclosed the fact that he had been used as a subject by a person who was studying hypnotism, and had thus become very susceptible to the influence of suggestion. I would not advise talking hypnotism, or even mentioning hypnotism to a patient, but used in this way you will find suggestion a very helpful influence in anæsthetic work.

Having mentioned the assistant, let me say a word about her before we finish this subject. A thoroughly trained assistant is three-fourths of the battle. The

assistant should be a cool, level-headed woman, physically strong, non-excitable, quick to think, and a keen observer. She should know anæsthetic symptoms; understand all resuscitation measures, and how to apply them; and be thoroughly interested in the work. If you can not teach your assistant these requirements; if she is timid and can not learn self-command, you had better get another assistant, or get a trained nurse to stay with you a while until the assistant learns how to properly assist you. You can teach her yourself if you take pains to do so, out of office hours, or when you have leisure. Demonstrate the methods of artificial respiration on her, and have her demonstrate them on you.

While you are administering the anæsthetic, the assistant should stand on the left of the chair and watch the patient closely. When you begin to operate, she must then watch the patient for you, and notify you at once of the slightest abnormality. In addition to this, if you are to use more than one forcep, she must have ready the other instruments in the order in which you need them. She must see that the lower lip is not pinched; that the tongue is kept out of the way; that the cheek is distended; that the mouth-prop is removed at the right moment in multiple extractions; that roots, teeth and blood do not go down the throat. She must sponge the parts; lean the patient forward when necessary; **be equal to any emergency that may arise, and do all these things without being told.** All these things belong to the province of the assistant—

yours is simply to take charge of the anæsthesia and the extraction.

After the operation, the assistant must take charge of the patient, and if a lady, help her to dress. **A cheerful conversation is just as helpful now, as before the operation. She must keep patients encouraged so that they will dress and get out into the fresh air.** Some patients have the idea that they should lie around a while. This must be avoided; is not necessary with the briefer anæsthetics, although it is very important after chloroform or ether.

After the patient has left, the assistant can then clean all the instruments, boil them, and put them away. **I advise boiling after use so that if an instrument not laid out should be needed in haste, you can feel that it is not infected with mouth bacteria.**

Just in proportion as your assistant does these things well for you, will you be successful, provided that you are cool, non-excitable and a good extractor. **The poorer the assistant, the more of her work you have to do, the greater will be the chance of failure.** With such an assistant as I have described, you can give your whole attention to the extracting. **The operator who does not know for a certainty if the patient has loosened her clothing; who relies on an accompanying friend or some one called hastily to act as a witness, in lieu of an assistant, is the man who makes failures in the use of anæsthetics.**

If you have not, and can not procure such an assistant as I have described, then you must do your best to allay the fears of your patients yourself. You can

do this before the patient takes the chair for examination, while you are examining the case, and before you give the anæsthetic.

An anæsthetic should never be administered to a woman in a dental office without the presence of another woman. Scarcely a day passes that some woman does not say to my assistant, "I am so glad to find a lady here." That very fact has a quieting and soothing effect on the patient. No woman wants to pass into unconsciousness in the presence of a man with her clothing unloosened. Again, especially under the influence of nitrous oxid, patients sometimes have amorous sensations, and a woman might dream that improper liberties were taken by the operator. There is a case on record where the presence of mother and sister failed to convince a girl that something improper had not occurred. The following case came under my observation. One Sunday morning, a lady came to my office to have a tooth extracted, being accompanied by the man she was to marry that evening. I administered nitrous oxid gas, the man standing on the left side of the chair holding the patient's hand—no one else was in the room. While under the influence of the anæsthetic, the patient gave evidence of undergoing an erotic dream. She awoke crying, wringing her hands and screaming at the top of her voice, "Ford, you have ruined me; Ford, you have ruined me," twenty times or more. The situation was extremely embarrassing. I stepped into an adjoining room, and from the conversation, every word of which I could hear, it was evident that the bridegroom was unable to

convince her that she had not been wronged, and she left the office in that state of mind. In "Turnbull on Anæsthetics," you will find a number of interesting cases that he has collected very similar to the one I have narrated.

I neglected to say that while anæsthesia is being induced perfect quiet must be maintained in the room. **No talking or whispering should be tolerated, and no words spoken, except those of suggestion to the patient.** This should be continued even though the patient, apparently, is asleep. Some patients do not lose entirely the sense of hearing. Again, sounds are exaggerated under the influence of anæsthesia and an ordinary tone of voice may sound very loud and be disquieting in the extreme. For this reason all suggestions to one undergoing anæsthesia should be made in a quiet, firm, subdued tone of voice. I speak not a word to anyone in the room while inducing anæsthesia, except to the patient. All communication with the assistant is conducted by means of signals. **This quietness should be maintained in the room after the operation, while the patient is returning to consciousness. Conversation is prohibited. If patients catch a few words while in the border-land between sleeping and waking, they will imagine that they knew all about the operation. In a low tone of voice, say, "You are now through sleeping; you are waking up, your teeth have been removed, and there has been no pain."** Language appropriate will come naturally to you for each case.

As soon as the extracting is completed, napkins

should be placed in the mouth to absorb the blood. For this purpose, my assistant uses the ordinary antiseptic dental napkins. These are folded so as to be about two inches in length, then rolled and a string tied about the middle. If you have a string tied to the mouth-prop, use a different-colored string for the sponges. If only two or three teeth are extracted, the moment the teeth are out place one or more of these napkins rolls under or over the sockets of the extracted teeth, just as you would insert a mouth-prop. If nitrous oxid gas or somnoform has been the anæsthetic used, leave the patient undisturbed until he is sufficiently awake to rinse the mouth with water. First remove the napkins, then the mouth-prop. Always follow this order, as you might be deceived as to the amount of relaxation of the muscles and the mouth might close tightly, retaining the napkins and thus endanger breathing if the prop was removed first.

Never lean patients forward after extracting until they are sufficiently aroused to free their mouths. There are two reasons for this: First, before consciousness has returned, patients usually pass through a dazed and confused dreamy stage, and, not knowing where they are or what has occurred, may have a bad dream at being suddenly aroused. Upon seeing blood, men are liable to think that they have been in a scrape of some kind, or that they have been attacked, and you may have a fight on your hands. If you try to have them spit before they are sufficiently awake, they are liable to spit in your face, or on the walls or the floor, or anywhere. Others, being frightened when

they go to sleep and feeling that they may never wake up, imagine when you disturb them that you are trying to resuscitate them. Second, it predisposes to nausea. I believe that **nearly all the nausea accompanying nitrous oxid gas or somnoform,** the clothing being properly arranged, **is the result of raising patients up too soon to get them to expectorate.**

In larger extraction cases, by keeping the mouth-prop in place the blood can be sponged from the mouth as in any other surgical operation. When used in this way, do not fold the napkin, but use it as a sponge.

The modern dental chair is responsible for many anæsthetic failures. At least, that has been my experience. I have tried nearly all chairs that have been on the market the past thirty years, and, while the old Archer has its faults, nevertheless it is superior, as an anæsthetic extracting-chair, to all other dental chairs, when nitrous oxid, ethyl chloride or somnoform are to be used. The old wooden Archer chair with the detachable foot-rest is the chair with which I have been most successful. This is a surprising statement, but a trial is convincing. I have an old Archer and also one of the most modern of chairs in my office. Occasionally, to hurry matters when the Archer is in use, I slip a patient into the modern chair, to make an extraction, and nearly always promise myself that I **will never do so again.** The difference in the behavior of the patient is very evident. In the modern chair, the patient places his feet on the foot-rest and braces himself, pushing backward. This pushing with the feet causes the chest to rise, interfering with the inhaler;

pushing harder, the head-rest is forced to one side, or the head slides out of the head-rest, and you have to substitute your left arm as a head-rest. I have had patients force themselves backwards till their heads and shoulders were beyond the chair and have extracted in that position many times.

In the modern chair, frequently, when just about to extract or while extracting, one of the levers holding the head-rest in position will be touched accidentally by the arm or chest or by the assistant, the head falls to one side, one of the most annoying things to happen. I have had broken under nitrous oxid anæsthesia the foot-rest of two S. S. W. chairs, and the back of a Morrison chair, from force exerted by the patient, while extracting teeth.

The old Archer has a detached foot-rest on rollers. When the patient begins to push, the foot-rest rolls forward, and the legs stand out straight and rigid and the patient is perfectly helpless. The head-rest is secured by a thumb screw and there is no danger of its being released. The objection to the Archer chair is that it is too high for some teeth in the lower jaw. This objection is easily remedied by standing on a foot-stool or box made for that purpose. Next in preference is the Morrison chair. The foot-rest of the Morrison chair is so constructed that the part on which the heels rest when the legs are extended, the piece against which the patient would press when bracing, can easily be detached and left off. The Morrison then becomes an excellent chair for extracting

teeth under nitrous oxid, ethyl chloride and somnoform anæsthesia.

Not only does the head-rest yield by the force exerted when extracting in a modern dental chair, but it is no unusual occurrence for the back to give away when the patient is heavy or powerfully built. These accidents of the chair are perplexing in the extreme, and are responsible, I believe, for at least fifty per cent. of the failures under the agents mentioned when administered for tooth extraction.

In this lecture I have taken into consideration a number of little things, the things that are either overlooked by most operators or deemed unimportant, or too trivial to put into practice, but it is strict attention to these small things and following out such details that makes my anæsthetic work more successful than in former years.

LECTURE VIII.

Relative Safety of General Anæsthetics.

Nitrous oxid and oxygen is considered the safest and chloroform the most dangerous of anæsthetic agents in general use. I could quote pages of statistics to show the percentage of deaths that occur during anæsthesia, all by recognized authorities, but it would be a loss of time and of no value whatever. There is an old saying, "You can find what you look for," and this is more than true when you undertake to establish the relative safety of anæsthetics by statistics. Figures may not lie, but you can juggle them to suit your purpose, just as you can distort the truths of the Bible if you so wish. The following illustration is not logical or true, but Scriptural: "Judas went out and hanged himself"; "go thou and do likewise," "and whatsoever thou doest, do quickly."

The author who prints statistics to prove that one death occurs in every thousand administrations of chloroform may be set down as one partial to ether.

Another man is just as positive that the average fatality with chloroform is not more than one in four thousand. Wood, in the twelfth edition of his "Therapeutics," says the average mortality is one death in seven hundred thousand administrations of N_2O, while

a New York writer maintains there is but one death in one million administrations of N_2O. A Chicago man, a somnoform disciple, has recently stated that he is positive there is one death in every twenty-five thousand administrations of N_2O. Luke says there have been only thirty-five deaths, all told, during N_2O anæsthesia. This New York average is made from statistics of N_2O administered in New York City, covering a period of ten years, and looks good on the surface; but I am suspicious that this writer is as enthusiastic an N_2O man as the Chicagoan is a somnoform enthusiast. According to the New York statement, it is safer "to take" N_2O than to cross Broadway or Fifth Avenue; than to play football or ride on the elevated railway; to attend the theater or go slumming.

Think of it—only one death in a million administrations of N_2O!

The average of mortality is greater among men delivering a sermon or making a prayer, eating a meal or taking an afternoon nap, attending a banquet or indulging in a stroll.

Even with a showing of this kind for N_2O, almost beyond belief, the somnoform enthusiast is setting up the claim, in good faith, that somnoform is the safest of all anæsthetics. It almost makes one feel that we would be safer in an atmosphere of N_2O and somnoform than to inhale the poisonous, germ-bearing air of our offices.

I will take the liberty, however, to quote a few statistics to make clearer my position.

Statistics collected by Julliard:—

	Administrations.	
Chloroform	524,507	16 deaths—1 in 3,258
Ether	314,738	21 deaths—1 in 14,987

By Ormsby:—

	Administrations.	
Chloroform	152,260	53 deaths—1 in 2,873
Ether	92,815	4 deaths—1 in 23,204

St. Bartholomew's Hospital:—

	Administrations.	
Chloroform	19,526	13 deaths—1 in 1,502
Ether	8,491	3 deaths—1 in 2,830
N_2O and ether........	12,941	1 death —1 in 12,941

By Luke:—

N_2O ....1 death in 100,000 administrations
Ethyl chloride.......1 death in 12,000 administrations
Ether ....1 death in 10,000 administrations
A. C. E. and C. E....1 death in 7,500 administrations
Chloroform, at least 1 death in 1,000 administrations

Prinz, from recent statistics, covering 1,146,493 narcoses, gives the following:—

Chloroform ....1 death in 3,500 administrations
Ether ....1 death in 26,268 administrations
C. E. Mixture........1 death in 8,014 administrations

The German Central Society of Dentists has prepared a series of records of the number of general

narcoses and their fatalities, which are tabulated from the reports of its members, covering a period of four years (1902-1905). These statistics resulted in the following report:—

Chloroform	1 death in	42,215	administrations
Ethyl Bromid.......	1 death in	121,154	administrations
Ethyl Chloride....	No death in	70,630	administrations
Nitrous Oxid......	No death in	3,662	administrations

Pastre states that during the Crimean War only 1 death occurred in 10,000 administrations of chloroform.

There is no satisfaction to a seeker of truth in such an array of figures as quoted above. St. Bartholomew's Hospital statistics show that there is an average of **one death in every 2,830 administrations of ether,** while Ormsby shows **there is but one death in 23,204 administrations of ether.** Again, Luke says **there is one death, at least in every 1,000 administrations of chloroform,** while the German Central Society of Dentists **maintain there is but one mortality in every 42,215 administrations of chloroform.**

If the estimate is correct in regard to one death in 1,000,000 administrations of N_2O, no dental surgeon need lay awake nights worrying over mortalities. If an operator should administer N_2O ten times per day, including Sundays and holidays, and took no vacations, he would be entitled to only one mortality in 274 years of practice.

If we should take all the statistics that have been collected, and strike an average showing the ratio of

deaths to the number of times a given anæsthetic has been administered, it would have no bearing on the subject whatever. **These statistics are made to determine the percentage of deaths during anæsthesia, and have nothing to do with the relative safety of anæsthetics. What we want to know is the percentage of deaths caused by anæsthetics.** It is estimated that 105,000 people die every day of the year. We know that, in cases of injury, where men are so horribly mangled that there is not the least hope of recovery, for humane reasons they are hurried to a hospital, anæsthetized and operated upon, die during anæsthesia from their injuries, and these cases are all set down as deaths under anæsthetics. Many die on the operating table under anæsthetics, it is true, but die from disease, and these deaths help to make up the average. Many die at the close of a long operation from exhaustion; many more die from shock, as the result of operating too soon or too long; others die at the very beginning of the operation from spasm of the glottis, the anæsthetic, improperly administered; others die from an overdose of anæsthetic, others from collection of mucus, blood, vomit, etc., accumulating in the pharynx, and others die from apoplexy, heart failure, etc., just as they would have died had they not been anæsthetized. When we take into consideration that medical men and dental practitioners, almost all of them, except a few who are fortunate enough to become internes, must learn to administer anæsthetics themselves after graduating, it is surprising that there are not many, many, many more mortalities during anæsthesia. It

is said that "an occulist spoils a hatful of eyes learning to do a cataract operation." If this be true, Providence must indeed be kind to young men in their early anæsthetic career.

The medical student of to-day does not have as good an opportunity to familiarize himself with the administration of anæsthetics as students of twenty years ago. Formerly anæsthetics at surgical clinics were administered in the operating-room in the presence of the class; now they are administered in an adjoining room and wheeled into the pit, ready for the operation.

Yes, chloroform is the most dangerous of all anæsthetics, or rather, we have more deaths from chloroform than from any other anæsthetic. Chloroform is not so much to blame, however, as the anæsthetist. When we understand chloroform better, and avail ourselves of sane methods of administering chloroform, the death rate will not be so high.

It is impossible to ascertain the percentage of deaths caused by anæsthetics. I am satisfied in my own mind that the percentage of deaths caused by anæsthetics is very small as compared to the percentage of deaths that occur during anæsthesia. When the medical schools require as thorough training in anæsthetics as they do in anatomy, histology, pathology and chemistry, and the dental schools establish an anæsthetic clinic, as they have done in operative and prosthetic dentistry, I believe that in ten years the mortality under anæsthetics can be reduced 50 per cent.

The safest of all general anæsthetics is a combina-

tion of nitrous oxid and oxygen. Not only is it the safest, but likewise the most pleasant of all anæsthetics to inhale, and the patient recovers almost the instant the inhaler is removed from the face. This anæsthetic is applicable not only to brief and unimportant operations, but has been used on occasions in the gravest of conditions, when all other anæsthetics were contra-indicated. Not many months ago Dr. Teter, of Cleveland, succeeded in keeping a patient anæsthetized for nearly three hours with nitrous oxid and oxygen. On this occasion the patient inhaled 600 gallons of nitrous oxid, and, if I remember correctly, 80 gallons of oxygen. While this combination is the safest of all anæsthetics, it is the most difficult of all to administer.

The next in order of safety is nitrous oxid, and next in order of difficult administration is nitrous oxid. It is unfortunate that the most pleasant anæsthetics to take, and without doubt the least dangerous, should be the most difficult to administer. Dr. Laird W. Nevius, of Minneapolis, has administered N_2O nearly 100,000 times without an accident. Could these anæsthetics be handled as easily as ether or chloroform, without special apparatus and clumsy cylinders, there would be no need of the more dangerous anæsthetics now in common use. It was a triumph worth recording when the manufacturers learned to liquify nitrous oxid and place it in cylinders for our convenience. If the manufacturer would go one step further, and do for us what has been done with ethyl chloride and somnoform, in the way of putting it in a convenient

form for use, it would be a benediction second to the discovery of anæsthesia.

Somnoform, the most beautiful of all anæsthetics in its action, the easiest of all anæsthetics to administer, the most reliable of all anæsthetics for brief operations, so far as the record of deaths during anæsthesia shows, as safe as nitrous oxid. Properly administered, somnoform has no rival; for efficiency, it stands alone in a class of its own. You can come nearer getting a perfect result every time you make an administration, with somnoform, than you can with any other anæsthetic with which I am acquainted. In the hands of the skilful, intelligent anæsthetist, the careful, painstaking anæsthetist, as safe as the safest anæsthetic, but in the hands of the careless, ignorant, reckless anæsthetist accidents may arise from its improper administration.

While there have been but few deaths from nitrous oxid and oxygen, and only about thirty-five deaths during or as the result of nitrous oxid, in sixty-eight years of use, and the percentage of deaths from somnoform no greater than that of nitrous oxid, yet there is this to be said about somnoform: you might push it far enough to result in an accident without the patient showing much evidence that anything was wrong; while with nitrous oxid the patient's appearance and actions would be such as to alarm and frighten the anæsthetist, thus giving ample warning, as a dangerous condition was approached. You could tie a patient down, and smother him to death with any of the anæsthetics, if you held them over his nose and mouth

long enough, excluding all air, but you must remember always, **it is not what an anæsthetic can do, ad libitum, but what it does when properly and skilfully administered.**

Next in order of safety may be placed ether. Ether may be employed for brief operations, and is usually selected for prolonged surgical operations. The fact that the percentage of deaths during or as the result of ether administration has been materially lessened with improved methods, shows conclusively that the larger percentage of **deaths** in the past **are chargeable to the anæsthetist rather than the anæsthetic.**

A prominent surgeon told me recently that since the drop method of administering ether had come into such general use he did not think there was more than one ether death in 20,000 administrations. Hewitt, from a careful analysis of the statistics collected by him, **argues that ether is about seven times** as safe **as chloroform. Ether is certainly gaining in favor over chloroform,** and its administration is no longer considered a dangerous procedure. Indeed, **in the hands of a competent anæsthetist, the risk of ether anæsthetic accidents is infinitesimal.**

Ethyl chloride is very popular just now in England and on the Continent, and in our Eastern cities. As to the matter of safety, this anæsthetic may be classed between ether and chloroform. It is employed mostly for the induction of brief anæsthesia, and frequently as preliminary to ether. Luke gives this anæsthetic a death rate of one in twelve thousand. It is a peculiar circumstance that so many deaths should occur under

ethyl chloride, while somnoform, which is eighty-three per cent. ethyl chloride, is amazingly safe. I think in time improved methods of administering ethyl chloride will greatly reduce the death rate.

Chloroform is the most dangerous of all anæsthetics, or rather the percentage of deaths under chloroform is higher than that of any anæsthetic in general use. Chloroform, however, is not so much to blame as the careless, reckless, almost criminal, manner in which it is administered. A more intimate knowledge of chloroform, and a better understanding of its physiological action, along with improved methods of administration, will increase its efficiency and decrease the percentage of mortality.

The fact that some anæsthetists confine themselves to the use of chloroform exclusively and have never witnessed a death during or as the result of chloroform anæsthesia, argues that **the manner in which chloroform is administered has much to do with the success or failure attained.** All or nearly all deaths that occur during the first two or three minutes of chloroform administration, are caused from fright, or because the vapor is too heavily laden with the anæsthetic. Those deaths that occur as the result of shock, because the patient is not sufficiently anæsthetized, are not chargeable to chloroform. Deaths happen under chloroform very suddenly at times, the pulse giving no preliminary warning, the breathing normal, and the patient evidently doing well, but these conditions arise when a large nerve is severed, or the vital organs handled or squeezed, or the vagus is dragged or

stretched. Hewitt says: **"It is by no means improbable that some of the sudden deaths which have occurred under anæsthetics and which have been ascribed to their action have in reality arisen from cardiac or pulmonary embolism."**

It must be remembered that in addition to the causes already enumerated that produce or lead up to death during chloroform induction or narcosis, that chloroform, **per se,** is a protoplasmic poison, and, when a sufficient amount has accumulated in the system, shock may arise from this cause. This is not probable if the anæsthetist will constantly keep in mind that **two per cent. of chloroform is sufficient to anæsthetize a patient and one per cent. is all that is required to maintain anæsthesia.**

As unusual care must be exercised in administering chloroform, and as most physicians are more familiar with ether, **it is safer to employ ether for all cases of extracting teeth, in which the choice lies between ether and chloroform,** whenever the extracting is to be done in a dental office.

It is utterly impossible to ascertain the percentage of deaths caused by anæsthetics. The best we can do is to determine the number of deaths that occur during anæsthesia. Hundreds of deaths are ascribed to anæsthetics, and they go down in history as anæsthetic deaths, when the anæsthetic was in no way responsible. It is customary for some physicians, and even some hospitals, to ascribe all or nearly all deaths that follow a surgical operation, to shock, the result of the anæsthetic. No matter how skilful a surgeon may be, and

no matter what may be the real cause of death during anæsthesia or following the operation, it sounds better to the family of the deceased, to the public and even to the surgeon himself, to have it said that the patient died from the effects of the anæsthetic than that he died as the result of the operation. When the report is spread abroad that the patient died from the effect of the anæsthetic, the case is closed. When it is whispered around that the patient died from the operation, the inference is that the surgeon was at fault, and some one has blundered. This is a factor that is to be taken into consideration when a death occurs during an operation, and for this reason we will never be able to ascertain accurately the number of deaths that are caused by the anæsthetic agent **per se.**

LECTURE IX.

Nitrous Oxid Gas.

Priestly discovered nitrous oxid gas, Sir Humphry Davy recognized its pain-relieving qualities, Horace Wells discovered its anæsthetic properties, Colton induced with it the first surgical anæsthesia, Riggs performed the first operation, the extraction of an upper third molar tooth from the mouth of Wells, and Dr. E. Andrews, of Chicago, was the first to add oxygen to prolong nitrous oxid anæsthesia.

A long and bitter controversy arose as to whom was due the credit of discovering surgical anæsthesia. **Dr. Burton Lee Thorpe**, in his biographical sketch entitled "Horace Wells, Dentist, Humanity's Greatest Benefactor, the Discoverer of Surgical Anæsthesia," in the **Dental Brief**, for July and August, '06, has settled that question forever. **Dr. Laird W. Nevius,** who as a young man practiced with Colton in New York City, in a volume of his own furnishes us with many interesting incidents relative to the early history of all the general anæsthetics.

In the year 1844, a Dr. Colton delivered a popular course of lectures on chemistry, and in the month of December happened to be in Hartford, Conn. He conducted his lecture course on the same plan as men have

been doing of late years on hypnotism. On this particular occasion nitrous oxid was discussed and members of the audience invited to the stage to inhale nitrous oxid to the point of stimulation to amuse those present. Dr. Horace Wells was present and with others took his place on the platform. He inhaled the "laughing gas," as it was then called, and was pleased with the sensation produced.

The exciting incident to him at the evening's entertainment was when Mr. Samuel A. Cooley, a well-known Hartford man, gave a lively exhibition of the effects of the gas by running and jumping about and falling, striking his legs against the wooden settees, and acting apparently perfectly unconscious of possible danger. After the effects of the gas had passed off, Dr. Wells asked him if he was hurt, and he replied that he did not know it at the time, but on looking at his legs, found them bleeding from injuries received. Dr. Wells, turning to Mr. David Clark, said: "I believe a man, taking gas, could have a tooth extracted, or a limb amputated, and not feel the pain." (Thorpe.)

The events of the evening so impressed Dr. Wells that, after the lecture, he went to the home of Dr. Riggs, of pyorrhœa alveolaris fame, to discuss the matter with him, and decided that he would inhale the gas on the morrow if Dr. Riggs would operate for him. Next morning, at the office of Dr. Riggs, Colton administered the gas, Wells inhaled it, and in the presence of Cooley, Dr. Riggs extracted an upper third molar, Wells exclaiming after remaining unconscious

a few seconds, **"I did not feel so much as the prick of a pin—a new era in tooth pulling."** (Thorpe.)

Twenty-five years after Priestly discovered nitrous oxid gas, Sir Humphry Davy suggested that it might be used for relieving pain; but forty-four years again elapsed before Wells demonstrated this prophecy, Dec. 11th, 1844.

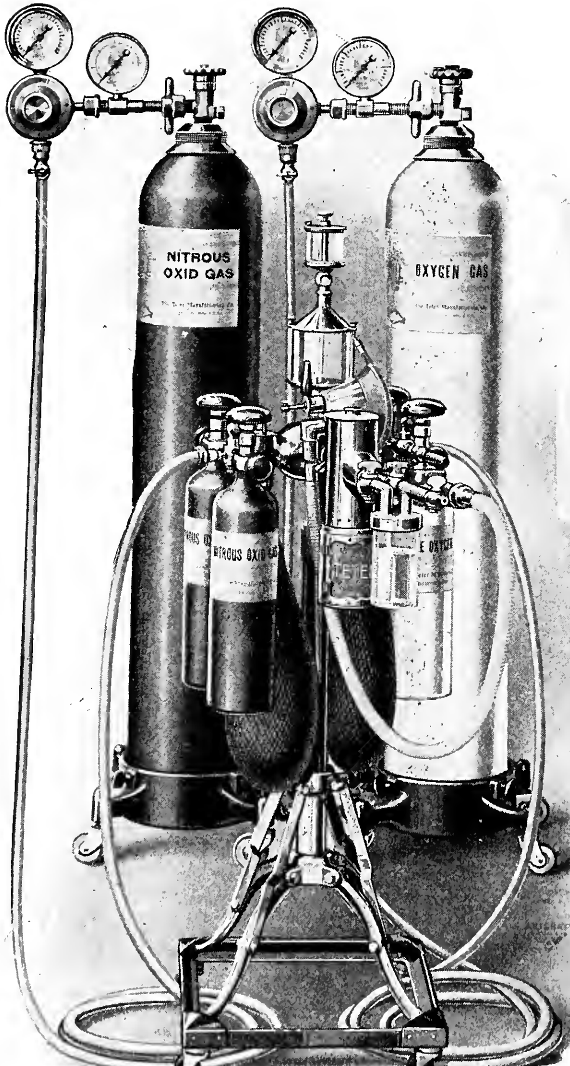
"On that day modern anæsthesia was given to the world, and nitrous oxid gas has proved to be a blessing to suffering humanity and the forerunner of all other anæsthetics." (Thorpe.)

I know not what name was used in the beginning to describe this state or condition we now call "anæsthesia." Two years later, when Morton, another dentist, discovered the anæsthetic properties of ether, **Dr. Oliver Wendell Holmes** wrote him: "Everybody wants to have a hand in the great discovery. All I will do is to give you a hint or two as to names or the name to be applied to the state produced and to the agent. The state should, I think, be called 'anæsthesia.' The adjective will be 'anæsthetic.' Thus we might say, 'the state of anæsthesia, or the anæsthetic state.'" (Thorpe.)

Nitrous oxid is a colorless, transparent gas of sweetish odor and taste, non-irritating to the tissues, and not unpleasant to inhale. Nitrous oxid gas is not a poison in itself nor does it form poisonous combinations or deleterious chemical relations with the constituents of the blood. It does not decompose during its passage through the circulatory system, the body temperature not being sufficient to cause disintegration.

Many theories have been advanced to explain the anæsthetic action of nitrous oxid. At first it was thought that hyper-oxygenation of the blood, the result of the oxygen and nitrogen separating and the oxygen being absorbed by the blood, was the cause, resulting in an internal asphyxia. Later, Duret and Blanche maintained that the anæsthetic effect of nitrous oxid depended on an insufficient amount of oxygen rather than a superabundance. It was these views that gave rise to the asphyxial theory; namely, that one who had inhaled a sufficient amount of nitrous oxid to produce anæsthesia was asphyxiated and not anæsthetized. Andrews, of Chicago, about this time, was adding oxygen to nitrous oxid to prolong the anæsthetic effect, producing by the use of this mixture a non-asphyxial anæsthesia. A non-asphyxial anæsthesia can also be obtained by the addition of air to nitrous oxid gas. Anæsthesia can be maintained for hours at a time by the addition of either oxygen or air, without the least asphyxia, proving conclusively that **nitrous oxid possesses anæsthetic properties of its own.**

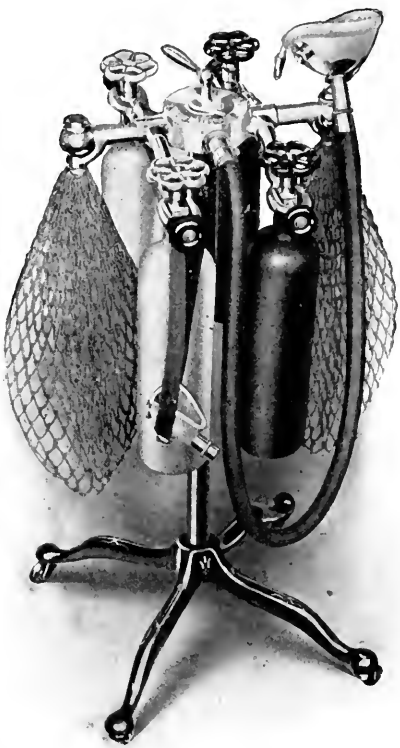
"The initial sensations under nitrous oxid are of an agreeable and stimulating character, almost identical with those of ether and chloroform; and, when non-asphyxial and deep nitrous oxid anæsthesia is established, this anæsthesia is similar, in its main features, to that produced by other anæsthetics. Were nitrous oxid anæsthesia the result of simple oxygen deprivation, we should not expect the initial sensations produced by the inhalation to be of an exhilarating character. Nitrous oxid has, in fact, quite as great a claim



The Improved Teter Apparatus No. 1, with vapor warmer and stand, attached to 2,500-gallon Teter nitrous oxid cylinder, and 1,000-gallon Teter oxygen cylinder, pressure gauges, etc. This appliance has an attachment by the use of which ether may be administered with nitrous oxid and oxygen in any proportion from one to twenty per cent.

as chloroform to be considered a general anæsthetic." (Hewitt.)

A mixture of nitrous oxid and oxygen can be inhaled indefinitely, but this is not true of nitrous oxid

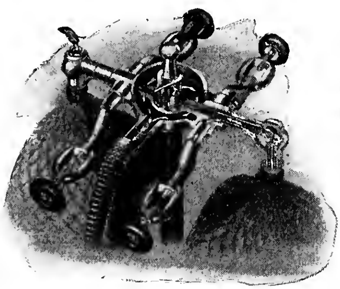


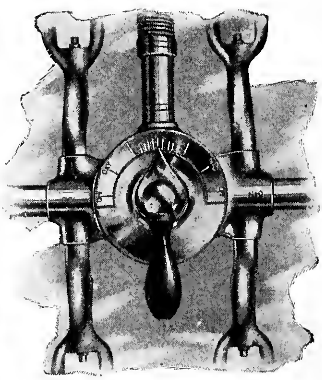
THE CLARK NEW MODEL OXYGEN AND NITROUS OXID GAS APPARATUS.

alone. Nitrous oxid does not support animal or vegetable life, and it is not safe to administer it even as long as one minute if all air be excluded. "In the case of man, the average inhalation period is 56 seconds; at

the end of that time, fresh oxygen must be admitted or permanent asphyxia will result." (Hewitt.)

Claude Martin, of Lyons, administered a mixture of nitrous oxid and oxygen to a dog for three consecutive days, and the dog was none the worse. Only fifteen per cent. of oxygen was used.





THE CLARK MIXING DEVICE.

METHOD OF CHANGING THE MIXTURE.

When the pointer is at nitrous oxid, the opening from the nitrous oxid bag is wide open. When the pointer reaches the marking, the first mark indicates that the valve is now at the opening leading to the oxygen outlet and moving the pointer any further in the direction of the oxygen side will begin to mix oxygen with nitrous oxid.

The further the valve is turned in the direction of the oxygen the more oxygen is allowed to escape, until the point "mix" is reached. At this point, if the bags contain the same amount of gas, equal amounts of nitrous oxid and oxygen are going to the inhaler. After the pointer passes "mix" a larger percentage of oxygen than nitrous oxid is being given, and this increases until the markings on the oxygen side is reached, when the nitrous oxid is shut off entirely and oxygen only is then passing through the outlet.

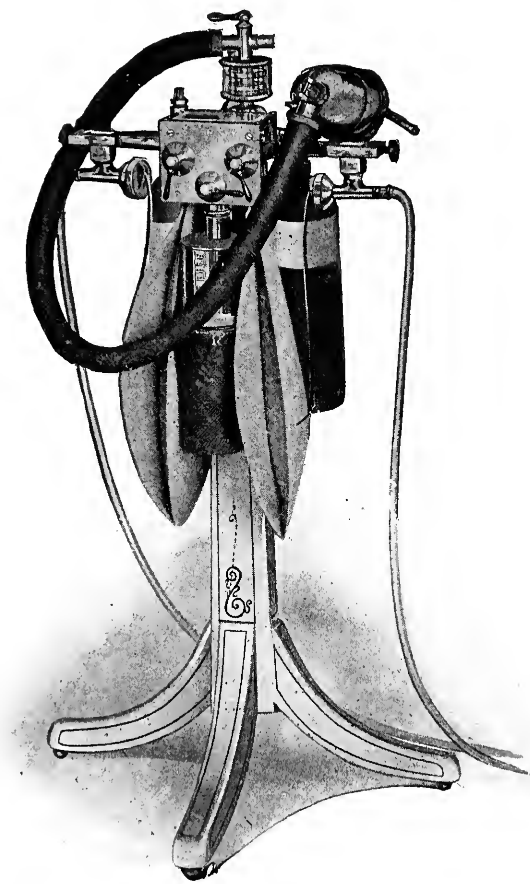
The operation of the valve is so simple that the one using it can make no mistake. If more oxygen is required, or more nitrous oxid, it is simply a question of moving the large handle one way or the other, until the mixture best suited to the patient is obtained. The appliance as shown here is equipped with 100-gallon cylinders, but it can be used in connection with the large cylinders with gauges and pressure indicators if desired.

When animals are killed by pure nitrous oxid gas, an examination shows the right cavity of the heart to be full of blood and the left cavity empty; the same condition is found when animals die of asphyxia. Post-mortem examinations of patients who have died under nitrous oxid, as reported by Hewitt, when asphyxia has been assigned as the cause, have also disclosed the fact that the right cavity of the heart was full and the left empty. Johnson believes that however asphyxia is induced—whether by nitrous oxid, by nitrogen or by paralyzing respiration by curare—the same effects follow.

It is not difficult to understand, as nitrous oxid produces asphyxia if air is excluded, and the post-mortem examination of an animal that has died from nitrous oxid shows the same pathologic condition of the heart as is found when death results from asphyxia, that nitrous oxid should have been classed as an asphyxiating agent rather than an anæsthetic agent. It is generally conceded that nitrous oxid is a heart stimulant and causes increased blood pressure.

Kemp thinks that contraction of the renal vessels takes place, resulting in a decreased urinary secretion; also that albuminaria is produced in a slight degree in complete narcosis.

An overdose of nitrous oxid produces death in nearly all cases from asphyxiation, the heart in some cases continuing to beat for a period of several minutes after breathing ceases. Hewitt thinks the immediate cause of respiratory arrest is usually muscular spasm.



The McKesson Apparatus with two small tanks as they may be attached, and showing the automatic bag-filling valves connected by small rubber tubings, which may be attached to a gas plant, large cylinders or, with a special yoke and pressure-reducing valve, to one or two small tanks in another room.

The technic of administering gas and oxygen with the McKesson Apparatus is easily acquired, because the instrument works automatically. Without attention, it keeps the supply bags properly filled with their respective gases, produces an absolutely uniform mixture, permits the patient to rebreathe only a certain desired portion of each exhalation, prevents contamination of the oxygen and nitrous oxid supply bags with breathed gases and

Nitrous oxid gas is made by heating ammonia nitrate. The gas thus generated passes through two or three wash bottles to absorb any impurities that may be present, and is collected in a large tank or gasometer.

In an early day it was customary for dentists to manufacture their own nitrous oxid, but at the present time only a small number of the extracting specialists and those using gas in large quantities make their own gas. There are obstacles to be met and overcome in the manufacture of nitrous oxid, such as inability to obtain the same grade of ammonia nitrate each time, and regulating the requisite degree of heat to obtain uniform results; for these reasons and other annoyances, even the extracting specialists are turning to the wholesale manufacturers for their supplies of this anæsthetic agent.

Farraday, in 1823, succeeded in liquefying nitrous oxid gas. The manufacturers have taken advantage of this discovery and have learned how to condense nitrous oxid. This is done under immense pressure at a low temperature, and, in order to confine the gas in this state, heavy steel cylinders are used. Cylin-

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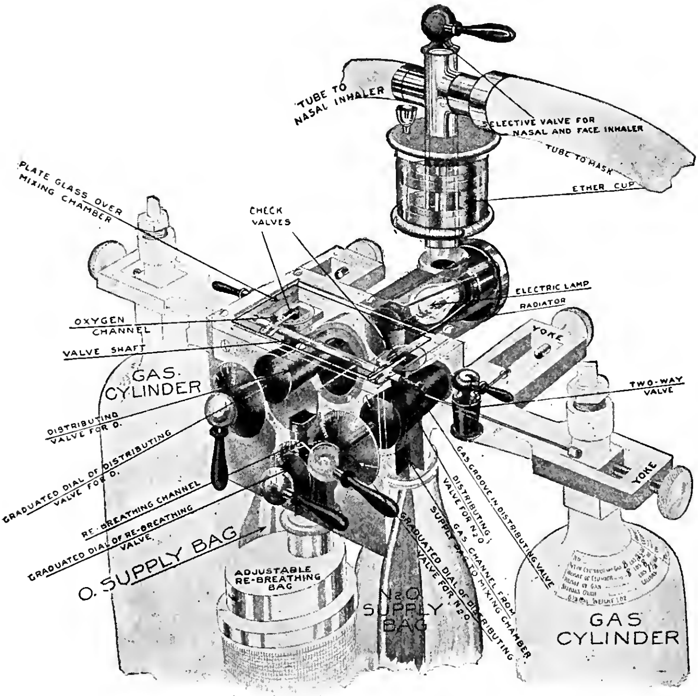
warms the gas before entering the air passages. The anæsthetist holds the mask to the face, sets the oxygen and nitrous oxid percentage valves for whatever mixture of these gases he desires, determines the volume of tidal respiration and sets the adjustable rebreathing bag for whatever portion he wants the patient to rebreathe, if any. He then watches his patient for the symptoms which will indicate whether the mixture is correct or not and makes such corrections as are necessary. A beginner who is familiar with the properties of this anæsthetic and who is thoroughly acquainted with other anæsthetics, will often give a successful gas-oxygen anæsthesia of an hour for major surgery on the first trial.



AN X-RAY VIEW OF THE M'KESSON APPARATUS PROPER, SHOWING THE CONSTRUCTION IN DETAIL.

1. Automatic self-filling bags.
2. Square gas channels with valves which actually represent the percentage of each gas used.
3. Both N_2O and O check valves are mounted on the same shaft so that the oxygen valve cannot "stick," but opens with each inhalation, resulting in a smooth anæsthesia.
4. A separate, adjustable, graduated bag for rebreathing, which measures the tidal respiration in cubic centimeters (a source of valuable information) and permits of instantaneous adjustment for any amount of rebreathing to be performed automatically and uniformly. If desired the gas from the "Bronchia tree" only, amounting to 140 c. c., which contains no CO_2, may be stored at each exhalation, to be rebreathed at the next inhalation, thus saving 73 gallons of gas per hour and in no way interfering with anæsthesia or the safety of the patient.
5. Moving parts are always visible through the plate glass cover.

ders are now being made that contain as small an amount as twenty-five gallons to those that contain as much as thirty-two gallons of nitrous oxid. As nitrous oxid gas does not deteriorate with age, the larger cylinders are more convenient for dentists remote from a dental depot who have to pay transportation charges. One feels far more comfortable with the larger cylinders when administering nitrous oxid for a prolonged surgical anæsthesia, and even in dental practice it is assuring to feel that there is sufficient gas for the operation without the annoyance of changing cylinders. Taking into consideration the transporta-

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6. A very light face piece with an expiratory valve so guarded that the inhaled breath cannot be blown toward the operative field.

7. A practical ether cup, which may be used in a variety of ways: (A) For the administration of ether in conjunction with N_2O and O, thus securing relaxation in the most refractory patient. (B) For the administration of ether with air and pure oxygen. (C) For the administration of ether with rebreathing and other combinations.

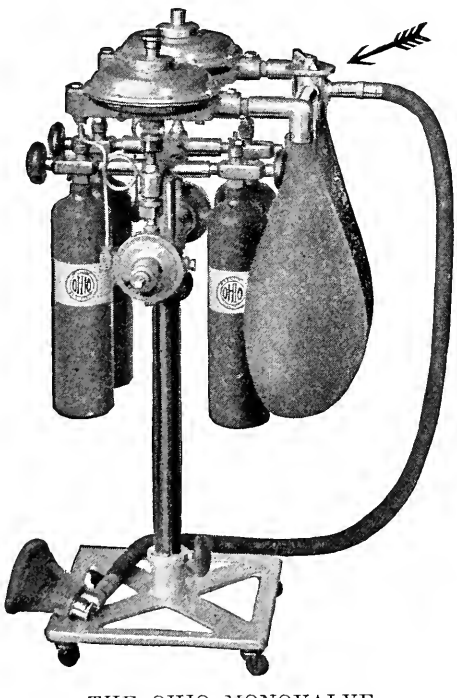
8. Compactness. The apparatus may be carried in its case and sufficient gas in the other case for a three to four-hour administration at the patient's home.

Rebreathing should be done not primarily to save gas, but to prevent "over-ventilation" of the blood from rapid respiration, which is a factor in the causation of shock. The patient ordinarily should not take more fresh gas than he would breathe of air, normally (7,000 to 8,000 c. c. per minute). If he breathes 30 times per minute of 500 c. c. or 1,500 c. c. per minute, the rebreathing bag should be set for one-half that volume or 250 c. c., so that at each inhalation he will rebreathe 250 c. c. of the previous exhalation and but 250 c. c. of fresh gases, thus restoring the normal ventilation of the blood and preventing excessive loss of CO_2, and the tendency to develop shock. With a ventilation below 8,000 c. c. rebreathing should not be permitted.

With this apparatus the only anæsthetic which approaches absolute safety may be easily, smoothly and scientifically administered for any operation. With a nasal inhaler, the dentist or physician may obtain a state of analgesia for prolonged periods without assistance while intra oral or other work is being done. Or a profound anæsthesia for removal of teeth, tonsils, adenoids, etc., may be continued as long as necessary.

tion charges and the loss in each cylinder when the gas does not come out even, the larger cylinders are far more economical than the smaller.

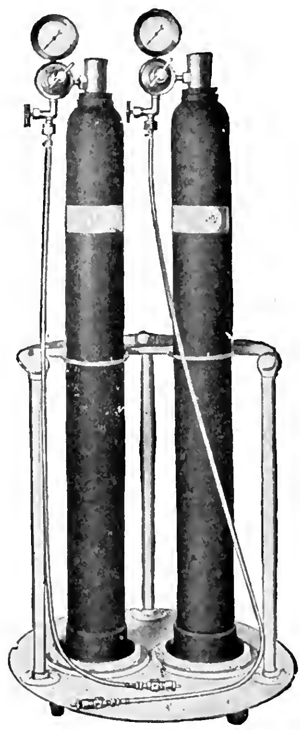
In the earlier manufacture of cylinders, annoyance and inconvenience was caused from imperfect valves.



THE OHIO MONOVALVE.

For the administration of nitrous oxid and oxygen. Chloroform and ether can also be used with this appliance in combination with nitrous oxid and oxygen. A device for warming these gases can be easily attached. This appliance, as shown in the cut, is equipped with 100-gallon nitrous oxid cylinders and 40-gallon oxygen cylinders. It can be connected up with the larger cylinders containing as much as 3,200 gallons of nitrous oxid and the amount of oxygen corresponding. The appliance is manipulated by the operation of a single valve.

These valves would permit the gas to escape and sometimes only one or two administrations of nitrous oxid could be made from a one hundred-gallon cylinder. It is embarrassing, when you only need two or three more inhalations to complete an anæsthesia, to



NO. 1 PORTABLE STAND, WITH STYLE F CYLINDERS.

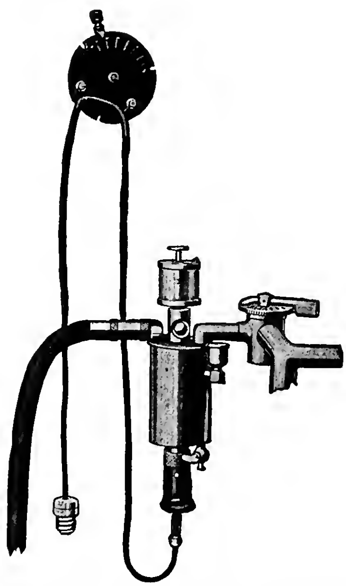
Cylinders hold 350 gallons oxygen and 1,280 gallons nitrous oxid. Stand can be omitted and wall clamps supplied when desired.

The regulators automatically reduce the gas pressure, causing an even flow which can be perfectly controlled.

These cylinders are manufactured by the Ohio Chemical Company and used with their Ohio Monovalve Appliance.

find the cylinder exhausted, which is supposed to be two-thirds full. Four gallons of nitrous oxid weigh one ounce. It requires five and one-third gallons of oxygen to weigh an ounce.

One hundred gallons of nitrous oxid should weigh just about 25 ounces. Each cylinder has marked on it or on a tag attached to it the weight of the cylinder and the weight of the gas. It is a good plan to weigh the cylinder when you unbox it and ascertain if there has been a leakage and about how much.



WARMING DEVICE, INCLUDING ETHER OR CHLOROFORM ATTACHMENT FOR OHIO MONOVALVE.

Gas passes through a radiator in a receptacle filled with water. The water is heated by electricity and temperature controlled by a rheostat. In the absence of electricity the hot water can be renewed during long operations. Ether or chloroform are regulated to drop as frequently as desired on a hot surface, causing perfect expansion of the liquid to gas.

If an administration has not been made for some time and you are in doubt as to the amount of nitrous oxid that should be in the cylinder, it is better to weigh the cylinder than take the risk of having the gas a little short of enough to induce the desired anæsthesia.

Just recently the manufacturers have equipped their large cylinders with pressure regulators, enabling one to tell the number of gallons of these gases that remain in the cylinders at any time.

The more modern appliances are provided with two or four cylinders, so arranged that you can switch from an empty to a full cylinder; but even this involves a loss of time and division of attention when the operator should not be interrupted.

The matter of appliances is an important one. There are many from which to select, each having its advantages.

The addition of oxygen to nitrous oxid for the purpose of prolonging anæsthesia has resulted in a modification of the older appliances to adjust themselves to the new condition. Nitrous oxid without the addition of oxygen can be used in all the appliances to which I shall call attention or describe.

LECTURE X.

Nitrous Oxid Administration.

For the sake of convenience, we will discuss this subject in the following order:

First: Nitrous oxid pure, without air.

Second: Nitrous oxid with an admixture of air.

Third: Nitrous oxid and oxygen.

There is only one anæsthetic more difficult to administer than nitrous oxid; namely, nitrous oxid and oxygen. Too much apparatus is necessary in the administration of nitrous oxid to make it popular, and, for this reason it will never be universally adopted by dentists as ether and chloroform have been by physicians. When the physician operates, he simply operates and has no care of either the patient or the anæsthetic; but when the dentist has occasion to administer nitrous oxid he usually performs a three-fold service; namely, **plays the role of anæsthetist, assumes the care of the patient, and, in addition to these, performs the operation.** In other words, he assumes the duties of anæsthetist, nurse and surgeon. No surgeon would undertake to administer his own anæsthetic, care for the patient and perform an operation, **except in the extremest emergency;** yet the dentist assumes such a responsibility, and when failures result **blames** nitrous

oxid, never for a moment taking into consideration that he has attempted to accomplish too much.

It would be a simple matter to administer ether and extract a number of teeth without an assistant, as compared to administering nitrous oxid alone and extracting a number of teeth. With ether you could anæsthetize the patient sufficiently deep to complete the operation before beginning to operate; while, with pure nitrous oxid, you have only about ninety seconds in which to anæsthetize and operate, and there is too much for any man to do in so brief a time.

Nitrous oxid in itself is an excellent anæsthetic; it can do all that has been claimed for it, and those who have failed to successfully administer this anæsthetic are at fault, and not the anæsthetic. This is why in a previous lecture I laid so much stress on the importance of a well-trained assistant. Indeed, some of our most successful extracting specialists extract only, the assistant assuming the entire anæsthetic responsibility. Let us assume, then, in all that I shall say in regard to administering nitrous oxid gas, whether in the pure state or in combination with admixtures of air or oxygen, that a good assistant is as essential to success as an appropriate appliance, as a good anæsthetist or as a skilful extractor.

If you have not read the lecture on "Elements on Success," in regard to the proper preparation of the patient, both mentally and physically, preliminary to administering an anæsthetic, I recommend that you do so before perusing this lecture.

The patient having been made ready, as previously

explained, with a good assistant at the left of the chair, the patient properly and comfortably arranged in the chair, only the mouth-prop is lacking; that adjusted, we are ready to consider the administration of nitrous oxid.

Never administer nitrous oxid without first inserting a mouth-prop. Insert the mouth-prop the last thing before adjusting the inhaler. **It is never safe to administer nitrous oxid without a mouth-prop,** and I consider one **criminally negligent to do so.** There are a number of reasons why a mouth-prop should be used; the one we are interested in just now is to hold the jaws apart in order to facilitate speedy operating. Many dental surgeons fail just here. Under nitrous oxid anæsthesia, the masticatory muscles usually contract, sometimes violently. Having satisfied yourself upon removing the inhaler that the patient is sufficiently anæsthetized to begin operating, if a prop has not been used, the mouth will be found closed, and sometimes the teeth forcibly held together, and so much time is consumed in opening the mouth, if it can be opened at all, that **the tooth is fractured** in the hurry, or **the wrong tooth extracted,** or **the patient is hurt,** or awakes and **nothing has been accomplished.**

Hewitt gives the **average induction period of nitrous oxid gas without air as fifty-six seconds, and the average available anæsthesia about thirty seconds,** so there is no time for forcing the mouth open, and it is highly important that the mouth-prop be not neglected.

Let me say just here, **make it a rule never to hurt your patient.** The object in taking nitrous oxid gas

is to avoid the pain of the operation. If you lose too much time in getting started, you **better not operate at all** than to have the patient hurt. The patient will complain to all his neighbors that he knew everything that was done, and was never so badly hurt in his life, and advise everybody he meets for weeks against taking nitrous oxid. **Exercise the greatest of care, in the beginning, in the selection of suitable subjects.** The operation itself should be of the simplest nature. Some one may present with one easy tooth to extract, or two or three loose pyorrhœa teeth. With such a case, there is no anxiety about the operation, but your entire attention can be given to administering the anæsthetic, studying the patient and learning anæsthetic symptoms. It is unreasonable on your part to expect to obtain perfect results from the very first administration, and to start in as an accomplished anæsthetist. You do not expect to do this in other departments of dentistry when you take up something new with which you are not familiar.

It is an excellent plan to reserve the anæsthetic for such cases forty, fifty, sixty times or more, gaining confidence each time, and later undertake more difficult cases. If a patient presents "with a mouthful of teeth" to be extracted, make no promise in advance as to the number you will remove under one administration of nitrous oxid gas. If you should promise ten and succeed in extracting but three, you make a sad failure. Say this: "I will extract as many as I possibly can, and will not hurt you," and be sure to cease extracting before they feel pain. You might say that "much de-

pends upon the breathing," as explained, and that "some patients are more deeply anæsthetized than others." If you succeed in removing three or four teeth, you are safe; if you should succeed in extracting eight or ten teeth, your reputation is made with that patient. Whatever the number, be sure to stop before the patient feels pain. Better not extract at all if from nervousness the patient does not take the anæsthetic well; but have him return another day. **It will condemn any anæsthetic to operate too soon or too long and the patient feel the pain.**

In regard to extracting under nitrous oxid, let me say it is a very different proposition from extracting without an anæsthetic. It is **something that has to be learned,** no matter how skilful an extractor you may be. Without an anæsthetic, the patient keeps his tongue out of the way, and, in a degree, the cheeks, and the mouth opens wider if you wish it, and the head turns to one side or the other on command; but, under nitrous oxid gas, you must be careful not to wound the tongue or cheeks, must accommodate yourself to the space obtained by the mouth-prop, and operate speedily.

To return again to the administration of nitrous oxid gas, measures must be taken to exclude all air. Adjust the inhaler to the face and satisfy yourself that it fits accurately. The pneumatic cushion or rim should not be blown up too tightly, but about half full of air; then it can more accurately be made to conform to the features than when more tense or rigid. If the patient wears a heavy mustache or beard, especially the beard,

it is an excellent plan to dampen some surgeon's gauze and place three or four layers around the rim, then press this tightly against the beard with the inhaler. Have the assistant release the gas and allow it to pass into the rubber bag until it is almost full. Shut off the gas for a moment, open the exit valve and the gas in the bag will force out of the tube running from the bag to the inhaler the air it contains. It is very important that the valves should work accurately and sensitively. Adjust the face-piece carefully this time and see that no air can gain admittance under the pneumatic rim, the valves having been tested previously to ascertain if they are in perfect working order. **Instruct the patient to breathe deeply and regularly.** I prefer in the beginning that they take three or four inhalations of air through the inhaler, the gas being shut off; then gradually admit the nitrous oxid gas. From this time on, exclude all air. The assistant should now keep the gas bag nearly full, and, when the patient is sufficiently anæsthetized, be sure to turn off tightly at the cylinder.

Judging from my own experience, eight gallons is the average amount of nitrous oxid gas necessary to induce anæsthesia, when all air is excluded; Hewitt says six. In some cases, I have found two or three gallons sufficient; in others, fifteen or twenty gallons. Frail patients, children and anæmics are very susceptible to nitrous oxid gas; the plethoric and alcoholics require a greater amount. The condition of the patient, of course, is the test in all cases; nevertheless it was very satisfying under the gasometer plan when it was

possible to see the indicator and note the number of gallons that were being inhaled.

The induction period of nitrous oxid gas is so brief and the phenomena occur in such rapidity, that I have not been able to make a satisfactory classification of symptoms. The four anæsthetic stages are easily discernible under alcohol, ether and chloroform; but the action is so quick under pure nitrous oxid gas, ethyl chloride and somnoform, that I have not been able to differentiate them. Hewitt has more thoroughly investigated and experimented with nitrous oxid gas than any other writer, and he also speaks of the difficulty of classifying nitrous oxid gas phenomena into four groups; yet his intimate knowledge of the subject has enabled him to accomplish this, and we will follow his outline.

First Stage. Patients vary greatly in the matter of symptoms experienced during the inhalation of nitrous oxid gas. This is to be expected, because an anæsthetic does not destroy one's personality. No two patients probably have an identical experience. This is true in the more common things of life. I have been frequently annoyed at the theater by those about me laughing audibly when to me the grouping was pathetic, and at other times situations that appealed to me as humorous, brought no smile to the countenance of my neighbors. If you had an opportunity to treat five men to **a large drink of whisky**, just as they happened to be in a group, and kept them together long enough to study the effect, they would not react alike to this stimulant. One man would probably become

talkative, another feel like singing, another become drowsy, another no effect at all, according to their individual temperament. Even in the condition we call sleep, which is purely physiological, **individuals vary widely.** Some sleep lightly and are easily disturbed, while others sleep profoundly and nothing disturbs them. Some experience the wildest kind of dreams, horrible to relate; others in their dreams have visions sublime. Just as the harrowing incidents of the day disturb the mind to the degree of sleeplessness, so **in a disturbed mental state patients do not sleep quietly and tranquilly under an anæsthetic.** This condition and how to overcome it is discussed in the lecture on "Elements of Success."

When nitrous oxid is adminstered properly, the patient having been made ready mentally and physically, the sensations experienced are more likely to be of **an agreeable than of a disagreeable character.** This is characteristic of nitrous oxid when inhaled experimentally, and, if it is not so when an operation is to be performed, it shows that the **disturbed mentality incident to the operation is the disturbing element rather than the nitrous oxid gas.**

Should the apparatus possess valves which do not work easily, or should the channels through which the gas is made to pass be too small, or should the patient through the want of confidence or knowledge breathe in a shallow or restricted manner, or through the nose, an unpleasant experience may result. **Hewitt insists on mouth breathing** when pure nitrous oxid gas is being administered. I never instruct patients in regard

to this point, lest they become confused, but in the deep breathing required, when the mouth is held open by a prop, think there is a combination of both nasal and mouth inhalation and that the latter predominates. An "indescribable pleasant numbness all over the body and a feeling of warmth in the lips" are amongst the first sensations experienced. Following these is a peculiar pleasurable "thrilling" which hardly admits of description. Then follows, with some, a ringing in the ears, tinnitus, and a fulness in the head, caused by increased circulation of the blood. It is at this stage that those who are affected unpleasantly begin to hear and see things, and the quicker over, the better. The loss of consciousness comes on now before the patient has time to define his feelings. The pulse grows fuller under the finger; and its caliber is somewhat increased at this stage. The power of hearing still persists and noises or conversation have a tendency to excite the patient. In my early anæsthetic practice I used a small music box and it was just at this stage that the assistant was signalled to touch it off. The average time of this first stage, from the commencement of the inhalation of nitrous oxid gas till the loss of consciousness, is about thirty seconds.

Second Stage. With the loss of normal consciousness disturbed physical states arise. As a rule, the patient gives little or no evidence of such disturbance, more especially if allowed to remain perfectly quiet. If roughly handled, the patient is liable to become excited and move his hands and legs. Any injury inflicted during this stage may produce immediate reflex effects,

such as shouting, co-ordinate or inco-ordinate movements, but it would not be accurately remembered by the patient. This stage is often mistaken by dental surgeons for the anæsthetic stage and they begin to operate, and sometimes have disastrous results. The patient yells, screams, struggles, and if strong enough breaks away; frees himself if possible, and there are instances on record where the anæsthetist has suffered physical violence. Other operators at this stage, if the patient becomes a little nervous—attempts to move or struggle—imagine that this is one of the cases in which the patient does not take nitrous oxid well, "he is probably as deep as I can get him, I had better extract quickly," and he does and is apt to have a fight on his hands. A few more inhalations just at this time would have induced surgical anæsthesia.

Nitrous oxid is often accused of producing imperfect anæsthesia, because operations are sometimes commenced at this stage. Many nitrous oxid gas appliances have been relegated to the garret or laboratory on account of the chagrin felt by the dentist after an experience of this kind when neither the appliance nor the anæsthetic was at fault, the operator simply mistaking the second stage for the surgical stage.

Dreams are common, but are rarely distinctly remembered. These depend largely on the mental state of the patient at the time of losing consciousness, and sometimes on the kind of dreams experienced during natural sleep. I recall a patient who had apparently a horrible dream. She made the most hideous of noises, and seemed to be suffering the torments of the damned.

After she returned to consciousness, the friend who accompanied her told me the patient frequently had just such "nightmares" in her sleep at home. Fortunately the dreams that occur under nitrous oxid gas anæsthesia are usually of a **pleasing rather than of a disagreeable nature.** Hewitt maintains that it is a curious fact that unpleasant dreams are more common under nitrous oxid gas **per se** than under nitrous oxid gas and oxygen, probably because the anæsthesia in the latter case is deeper, so that operations or other interferences, which in the case of nitrous oxid gas itself might leave some disturbed impressions, are not capable of doing so when the anæsthesia is more profound.

In this stage respiration is still quicker and deeper than normal, and, save perhaps for an occasional swallowing, is perfectly regular. The pulse is still full and a trifle quicker than in the first stage. In some cases, a spurious form of stupor may occur and it is to be disregarded. The conjunctiva is sensitive to touch. The pupils usually grow larger as the administration proceeds. The eyelids are usually affected by a slight twitching; and, as the inhalation proceeds, they have a tendency to separate and to display the subjacent globes. As the lids separate and the eyeballs become more prominent and fixed, the features lose their normal color, and become dusky, then livid. Blonds are more susceptible to duskiness and lividity of features than brunettes. Sallow people show very little change of color. At the close of this second stage, **the respiration is deeper and fuller and the pulse stronger than at any previous time and the patient is in the best possible condition.**

LECTURE XI.

Nitrous Oxid Gas Administration—Continued.

Third Stage. The first indication that the patient is passing or has passed into the third stage of anæsthesia is usually afforded by the respiration. The breathing, which hitherto preserved its rhythm, now loses it, and a peculiar characteristic throat sound, sometimes described as "stertor," becomes audible. This sound is most probably **due to irregular spasmodic elevations of the larynx** towards the epiglottis and base of the tongue, and indicates the tendency to obstruction in the air-way at this point. It occasionally happens that the respiration becomes somewhat feeble; or expiration becomes somewhat prolonged and rather strained. These phenomena should, in the presence of other signs of anæsthesia, be taken to mean that the administration has been pushed far enough. Now is **the proper time to begin to operate. To wait longer is to invite danger.** The heart is still beating strong, and the pulse is very full and rapid. As to how much of an operation may be attempted depends largely upon the operator and also upon the patient. You can learn this only by experience. Some operators are more expert than others, some are quicker than others and have more confidence in themselves. Some dental surgeons seem

to know by intuition when to cease operating; others never seem to know the limitations of pure nitrous oxid gas anæsthesia. Some patients are more profoundly anæsthetized by the inhalation of, say, eight gallons of nitrous oxid gas than others, and the period of operating will be two or three times as long. With some patients, there is hardly enough time to make one difficult extraction, while others as many as eighteen or twenty teeth may be removed. **Remember that the average available anæsthesia inducted by pure nitrous oxid gas is only thirty seconds.**

A pulse that was one hundred and twenty immediately before the administration may, for example, rise to one hundred and sixty or more; whereas a pulse of eighty or ninety at the beginning of the inhalation will not exceed one hundred or one hundred and ten in the third stage. Immediately that air is admitted by the withdrawal of the anæsthetic, the pulse abruptly undergoes a marked change. It at once becomes slower and fuller. A pulse at one hundred and forty at the acme of anæsthesia may suddenly drop to about eighty per minute before the effects of the anæsthesia have passed off.

Various muscular phenomena may appear. When respiration undergoes the changes referred to, the arm, if raised, will generally fall. But there is a tendency for clonic muscular contractions to occur in all cases, and for tonic spasm to arise in many. In some cases, the facial muscles are chiefly affected by the convulsive seizure; in others, the whole body mildly oscillates, the spasm apparently chiefly affecting the trunk muscles;

in others, the hands, legs, and arms alone may twitch; whilst, in a fourth group of cases, the neck may be affected by barely perceptible clonic spasm, so that the head is felt to move with fine rhythmic jerks in one or other directions.

Dr. Buxton found that one-third of the men and nearly one-third of the women anæsthetized by him at the Dental Hospital displayed ankleclonus under nitrous oxid.

Micturition rarely occurs, but it is sometimes met with in children. Defecation is extremely uncommon.

The pupils in a majority of the cases are dilated in deep nitrous oxid gas anæsthesia. In some cases, however, they remain a moderate size or may be contracted. The conjunctival reflex, which will have persisted during most of the administration, becomes less marked or disappears. It can not be depended upon as a guide. The corneal reflex usually persists.

Fourth Stage. If all air has been excluded and the patient is still inhaling pure nitrous oxid gas, there is danger now of an overdose, which constitutes the fourth stage of anæsthesia. Hewitt has said that **dangerous asphyxia will occur in fifty-six seconds (average time) if all air is excluded, and he also states that the average time required to induce surgical anæsthesia is fifty-six seconds. There is then no working margin, and the anæsthetist should be extremely careful at this stage of induction.** As careful as we may be, however, to exclude air it is probable that some air has been admitted to the lungs. **Always be guided by anæsthetic symptoms—no one should think of gauging the**

time at which to operate merely by the watch. A gentleman from Australia gave an anæsthetic clinic at the Jamestown Exposition Dental Meeting. He would administer the anæsthetic for twenty-two seconds each time by the watch and proceed to operate regardless of the condition of his patient.

If an overdose of nitrous oxid gas is administered, the breathing becomes embarrassed and then ceases, either, as Hewitt, says, as the result of muscular spasm or by the more commonly accepted cause, paralysis of the respiration. **The more vigorous the patient, the more powerful will be the spasm.** At the time the breathing ceases, the color of the face is a deep purple, sometimes even black, pupils usually dilated, the eyelids widely separated, and the cornea prominent and fixed. In strong and vigorous patients, **the heart sometimes continues for a period of several minutes,** and, at the time that respiration ceases, it is not always depressed. On the other hand, in debilitated patients with weak or fatty hearts, delayed respiration will more speedily be followed by cardiac arrest. There seems to be no case on record in which death has resulted from primary circulatory arrest, following the administration of nitrous oxid gas.

As pointed out in previous lectures, it is **all important to observe the respiration, for as long as the respiration is properly performed, the heart will take care of itself.** It behooves the dental anæsthetist to **know respiration thoroughly,** and he should familiarize himself with the anatomy of the respiratory tract, especial-

ly the nerves that supply and control the respiratory muscles.

Swollen and enlarged tongue is common to pure nitrous oxid gas anæsthesia. This condition is dependent upon the engorgement of the blood vessels of the tongue. If the tongue becomes thus engorged, it is probable that the blood vessels along the entire respiratory tract are also congested. It becomes important to satisfy ourselves whether the patient has nasal stenosis, pharyngeal adenoids, enlarged tonsils, œdema of the uvulva, morbid growths of the soft palate, larynx or trachea, or any other condition that may impede or make more labored the respiration. When patients do not take nitrous oxid gas well and become unduly excited or cyonotic too soon, **the condition probably arises from some respiratory obstruction, rather than from nitrous oxid gas, per se.**

Hewitt made a careful search of the dental and medical journals for records of nitrous oxid gas deaths from 1860-1900, and found but thirty recorded. He has placed these in appropriate groups and they make a most interesting and profitable study. Class A he designates deaths undoubtedly due, partly or wholly, to nitrous oxid gas.

Case 1. Female, 38; stout; enlarged tonsils and uvulva; dental operation; double administration; asphyxia.

Case 2. Male, middle-aged; obese; dental operation; double administration; asphyxia.

Case 3. Male, 57; tongue enlarged by morbid

growth and fixed; dental operation; convulsive tremor and rigidity; asphyxial syncope.

Case 4. Male, about 50; dental operation; syncope.

Case 5. Female, 71; stout; corsets tight; food in stomach; dental operation; probably asphyxia.

Case 6. Male, 24; dental operation, syncope.

Case 7. Female, dental operation; mode of death uncertain.

Case 8. Male, 39; small and deformed lower jaw; dental operation; asphyxia.

Case 9. Female, dental operation; asphyxia probably favored by morbid state of upper air-passages.

Case 10. Male, 26; enlarged tonsils; receding lower jaw; short neck; dental operation; asphyxia.

Case 11. Female, 23; tight corsets; full stomach; dental operation; asphyxia.

Case 12. Female, 22; dental operation.

Case 13. Male; dental operation; asphyxia.

Case 14. Male, 12; large abscess in base of tongue; fixed lower jaw; opening abscess; asphyxia.

Case 15. Male, 7; very delicate; old standing pericarditis and pleurisy; dorsal posture; operation for adenoids; nitrous oxid given with air; syncope; no obstruction in breathing.

Case 16. Female, 27; food in stomach; double administration; vomiting; dusky pallor; syncope; operation on elbow.

Case 17. Male, 36; suppuration of neck; left tonsil swollen; incision of neck; nitrous oxid with air first given; then pure nitrous oxid; cessation of respiration;

death from asphyxia; at necropsy, larynx found to be odematous.

In 13 deaths out of a total of 17 deaths, the operation was classified as dental. And it would seem that in **nearly all of these deaths some pre-existing conditions were present to which these deaths might be attributed.** In Case 1, enlarged tonsils and uvulva and a double administration. Case 2, patient "obese" and double administration. Case 3, tongue enlarged by morbid growth. Case 5, corsets tight and food in stomach. Case 7, double administration. Case 8, small and deformed lower jaw. Case 10, enlarged tonsils. Case 11, tight corsets and full stomach.

Out of the thirteen dental cases, there were three double administrations, two with tight corsets, and two with full stomachs.

Nitrous oxid anæsthesia is so quickly induced and is of such brief duration that unpleasant after-effects are generally avoided. Once in a while, a patient with a very delicate stomach, one that is subject to car sickness or that strong odors of any kind affect unpleasantly, may become nauseated. **Weakness and exhaustion rarely follow.** Plethoric or full-blooded people, if they are subject to attacks of headache, may suffer a few hours from cephalgia. Patients more frequently leave the office stimulated and buoyant than depressed and morose.

Nitrous oxid, in my estimation, is not an ideal dental anæsthetic. It is entirely too brief in its action to be universally successful. As patients come to me to be anæsthetized from other operators, more condemn

nitrous oxid than praise it. Occasionally some one will say, "My experience with nitrous oxid was pleasant, the operation a success, and I would even go to Chicago rather than have a tooth extracted without it." For every expression of this kind I hear ten who declare with them nitrous oxid was a failure. Not only was the pain inflicted severe, but it was accompanied with a hideous nightmare. Those dental surgeons who are successful in administering nitrous oxid will think that I have overstated the case, but the hundreds of dentists who have discarded their gasometers and have, some of them, two or three kinds of nitrous oxid appliances hid away in closets and laboratories will say that I have understated rather than overdrawn the situation.

Thirty seconds of available anæsthesia are not sufficient for dental purposes. It is entirely too brief for the average dental surgeon and it is the average dentist that must be satisfied. Even our most skilled dental anæsthetists and our expert extracting specialists are many times defeated in accomplishing a certain operation on account of the brevity of pure nitrous oxid anæsthesia.

Its greatest advantage is its safety. It is safe only because the patient's behavior and appearance are such that the dental surgeon has not the courage to push the anæsthetic even to the proper stage for operating, and makes a sad failure. The bulging eyeballs, the dusky complexion, the stertorous breathing, the contortion of the face muscles and the distressed appearance of the patient frightens the dentist into operating

too soon, but no doubt saves the life of the patient in many cases.

Hewitt has said it is a dangerous procedure to exclude air for more than fifty-six seconds when pure nitrous oxid is being inhaled, and he also says that the average time required to induce surgical anæsthesia with nitrous oxid, with all air excluded, is fifty-six seconds, so it is evident that according to the acknowledged nitrous oxid authority, the point of surgical anæsthesia and the danger point are the same.

The dental surgeon in nearly all cases makes a failure of nitrous oxid; the extracting specialist through long training and frequent daily use knows the possibilities and limitations of pure nitrous oxid. But there is only about one extracting specialist to each thousand dentists.

Pure nitrous oxid as an anæsthetic has had its day. Only in the most simple cases of extracting should it be used, if at all. Indeed, there is no longer a necessity for employing this anæsthetic agent.

It has been demonstrated that by adding definite proportions of oxygen to nitrous oxid, instead of an available anæsthesia of thirty seconds, an indefinite anæsthesia can be maintained.

Not only can prolonged anæsthesia be maintained, but a safe anæsthesia. Anæsthesia is now possible without cyanosis, without jactitation, without approaching the danger line, as very few deaths have ever been reported as arising from nitrous oxid and oxygen anæsthesia.

Before discussing nitrous oxid and oxygen, which

naturally should be considered now, I wish to call your attention to

Nitrous Oxid Warmed.

I have learned that **nitrous oxid warmed is superior to nitrous oxid cold** as an anæsthetic. An appliance formerly used by me when teeth were to be extracted or for surgical operations had a thermometer in the "mixing-chamber," and I knew the temperature when nitrous oxid left that chamber if not when it entered the lungs. Although I knew that nitrous oxid as it passed out of the rubber bag was cold, I did not realize till I made the test for myself that the cold was so intense as it passed into the lungs. For an ordinary case of extracting in which eight or nine gallons of the gas is consumed the thermometer falls to 20° F.—or twelve degrees below the freezing-point. In prolonged cases I have seen the thermometer settle to 10° F. The gas passes first into the rubber bag, then into the "mixing-chamber," containing the thermometer, and from there through the tubing to the inhaler and the nose. How much the temperature of gas is raised passing through four feet of tubing, the nares and pharynx, rapidly inhaled, I do not know. But I do know that the mucous membrane over which the gas passes so rapidly becomes chilled, and that we are not warranted in turning such a cold draft into the bronchi and lungs. In a conversation recently with one of our leading physicians I was advocating the use of nitrous oxid preliminary to ether and chloroform. He remarked, "That was my custom for years, but it was productive of so

much bronchial and lung trouble on account of the irritating properties of the gas that I abandoned its use." "Why, man," I said, "nitrous oxid is not irritating." He insisted that it was. Then I asked him if he knew the temperature of nitrous oxid as it left the bag to enter the lungs; he said "no." I informed him—a blank look came over his face. In a moment he said, "It was the extreme cold, then, that caused my cases of bronchitis and pneumonia, was it not?" I know if I remove my collar and the mildest kind of a draft strikes the back of my neck, I have a cold and a stiff neck next day. If the outside of the neck is so sensitive to thermal changes, I should think the inside would become involved if I breathed deeply and rapidly a gas which entered my nose at a temperature of 10°-20°—below freezing-point.

With the gas warmed, the patient passes into as quiet and as beautiful an anæsthesia as we obtain with somnoform. No jactitation, seldom yelling, screaming and laughing so common with the usual method, and by admitting a small quantity of oxygen, no discoloration or asphyxia.

I have administered nitrous oxid **cold, thirty-three years** and nitrous oxid **warm fourteen years,** and I have not the language at my command to tell you how pleased I am with warm nitrous oxid.

Specialists who limit their practice to extracting teeth under nitrous oxid anæsthesia, who manufacture their own nitrous oxid, maintain it at the same temperature as the atmosphere of the operating-room, and this is one reason why they get so much better results

than the man who relies on the ordinary gas cylinder for his supply of nitrous oxid.

I may be mistaken, but it is my belief that much of the struggling, the jactitation, the wild dreams and horrible nightmares experienced so frequently during nitrous oxid anæsthesia are caused by the cold nitrous oxid stimulating the nerves of the bronchi and lungs and they in turn reflexly communicating with the central nervous system. However this may be, I do know that with the method I am now using of warming the gas the anæsthesia resulting is quiet and peaceful and free from dreams or visions of an annoying character.

Most of the new anæsthetic appliances have a warming device through which the nitrous oxid passes, raising the temperature to about 85-90° F. If all anæsthetics were inhaled at a temperature equal to that of the body the anæsthetic agent would be more quickly assimilated by the blood and more easily eliminated from the system and would do much to maintain a normal body temperature throughout the period of anæsthesia.

LECTURE XII.

Nitrous Oxid and Oxygen.

Oxygen is a supporter of life, but nitrous oxid gas is not. Priestly, who discovered both nitrous oxid and oxygen, reported some very interesting experiments. He placed small animals under two receivers, one filled with oxygen and the other air. **Those under the receiver filled with oxygen lived twice as long as those under the receiver filled with the air. The death of birds in the receiver filled with oxygen transpired without convulsions while the death of the birds in the receiver containing air was always accompanied by convulsions. The heart retains its irritability for hours when death takes place in oxygen, but this is not the case when death takes place in air.** [Gwathmey.]

"Demarquay immersed two kittens in water and kept them there until they had lost consciousness and were completely asphyxiated. One had been previously confined for twenty minutes in a glass case containing two parts oxygen and one of air, the other had breathed only atmospheric air. On removing them from the water there was only a slight movement of the lower jaw. At the end of a minute and a half the superoxygenated kitten arose and totteringly walked around and made an uneventful recovery. The other

partially recovered at the end of fifteen minutes, but died the next day. These experiments were repeated a number of times, but always with the same results." (Gwathmey.) I stated in the last lecture that nitrous oxid when inhaled does not resolve itself into its component parts, but remains as nitrous oxid. If you add pure oxygen to the nitrous oxid gas and then inhale it, something very different may happen. Some of the oxygen inhaled passes into the blood to form a loose chemical combination with the red corpuscles; oxyhamaeglobin. **Life in this way can be supported indefinitely, the oxygen supplying food for the blood,** which in turn feeds the tissues while the nitrous oxid is anæsthetizing the patient.

Is it not reasonable, then, that I should **recommend the use of nitrous oxid gas plus oxygen in all cases in which nitrous oxid is indicated?** With nitrous oxid, the period of available anæsthesia is but 30 seconds; **with nitrous oxid and oxygen, you can operate as long as you wish.** With pure nitrous oxid, when all air is excluded, "the average inhalation period is fifty-six seconds; at the end of that time, fresh oxygen must be admitted or permanent asphyxia will result" (Hewitt); while **with nitrous oxid and oxygen, in proper proportions, there is no asphyxia.** All deaths arising from nitrous oxid are supposed to have been caused by asphyxia. The clonic muscular spasms or "jactitation" so common under nitrous oxid rarely occurs under nitrous oxid and oxygen.

While Andrews, of Chicago, was the first to use nitrous oxid and oxygen as an anæsthetic, **Hillischer,**

of Vienna, was the first dentist to systematically employ nitrous oxid and oxygen in definite proportions. He states that he "has administered 'Schlafgas' to patients of all ages; to those suffering from advanced affections of the heart; to those with diseases of the lungs; and to the subjects of epilepsy and other nervous diseases. He further states that he looks upon this gaseous mixture as absolutely without contra-indication—that he administers it to every patient irrespective of any morbid state which may be present. He admits that more experience is needed in administering 'Schlafgas' (nitrous oxid and oxygen) than in giving any other anæsthetic with which we are acquainted; and there can be no doubt that here, again, he is correct." (Hewitt.)

Apparatus.

All modern nitrous oxid appliances are so arranged that oxygen can be administered in combination with nitrous oxid gas in definite proportions. This is accomplished by the addition of a cylinder of oxygen attached to the appliance in a convenient position. A second rubber bag is used to contain the oxygen. These appliances have a "mixing-chamber." The nitrous oxid gas passes from its cylinder into its rubber bag and from thence into the mixing-chamber. The oxygen passes likewise from the oxygen cylinder into the oxygen bag, from which it finds its way also into the mixing-chamber. The two gases combine here in the proportions desired.

There is a device so adjusted that the amount of

oxygen passing out of the oxygen bag can be controlled or regulated. Although not scientifically accurate, it is an advance in the right direction.

The amount of oxygen necessary to prevent cyanosis and muscular spasm varies somewhat with the individual. If we rely upon the oxygen in the air to overcome spasm and cyanosis, so much air is necessary that it modifies anæsthesia. On an average, it requires about 8% of oxygen, and in order to abstract that much oxygen from the air it would require 40% of air. It requires about 92% of nitrous oxid to anæsthetize a patient deeply, so it is evident that if we admit 40% of air in order to obtain 8% of oxygen, we have left only 60% of nitrous oxid, which is about 32% short of the average amount necessary to induce deep anæsthesia. In other words, in the 40% of air which must be inhaled along with the nitrous oxid in order to furnish 8% of oxygen there is 32% of nitrogen that we do not need at all. It is evident, then, that when we utilize the air to furnish the requisite 8% of oxygen, we have only 60% of nitrous oxid for anæsthetic purposes, but when we admit 8% pure oxygen direct from a cylinder we have then 92% of nitrous oxid for the purpose of inducing anæsthesia.

It has been my experience that just **a little air admitted along with nitrous oxid is disadvantageous.** It prolongs the induction of anæsthesia, increases excitement, and there is more jactitation. Hewitt's experiments show that **patients can be anæsthetized when air is admitted up to 30%.** But with 30% of air it required 148 seconds to induce anæsthesia. **With 33%**

of air he failed to induce anæsthesia. With 3% to 5% of air the average inhalation period was 69 seconds.

It is well to remember that the **higher the percentage of air admitted, the longer it will take to induce anæsthesia and the lighter will be the resultant anæsthesia,** not on account of the oxygen that is abstracted from the air, but on account of the **smaller amount of nitrous oxid that enters the lungs with each inhalation.**

It becomes **very much easier and far more accurate to rely upon oxygen in a cylinder than to depend upon abstracting oxygen from the air.** By thus administering nitrous oxid and oxygen, excluding all air, **patients can be surgically anæsthetized indefinitely. Teter,** of Cleveland, recently anæsthetized a large, obese and plethoric patient, for a currettement and ovariotomy, the patient being under the influence of nitrous oxid and oxygen for two hours ond forty-eight minutes, **without one breath of air.** Nearly 600 gallons of nitrous oxid and 80 gallons of oxygen were used. The writer was present on one occasion when Teter maintained surgical anæsthesia for a period of two hours and thirty minutes without a breath of air. The patient returned to consciousness in less than two minutes after discontinuing the anæsthetic.

Administration.

Nitrous oxid and oxygen, unfortunately, is the most difficult of all anæsthetics to administer. It is without doubt the safest of all anæsthetics and but for the difficulties attending its adminstration would be the most popular and most generally used of all anæs-

thetics. I have already spoken of the difficulties incident to administering pure nitrous oxid, and, in addition to these, we have the added responsibility of feeding the oxygen in the right proportions at the right time. It is something that must be learned by repeated administrations. The more familiar you are with administering pure nitrous oxid the quicker will you become proficient in administering this combined anæsthetic.

Just as with pure nitrous oxid, some individuals and some types are more susceptible than others. **People enjoying robust health, strong and muscular, full-blooded and active are not as favorable subjects as the frail, the physically weak, and those of tranquil temperament.** All people who **drink or smoke to excess, whether coffee, tea or liquors, drug fiends and alcoholics, and those addicted to cigarettes and chewing tobacco are more difficult to anæsthetize** by this method than those of temperate habits.

Much depends, of course, on proper breathing; hence stenoses and obstructions of any kind whatsoever in the mouth, nose, pharynx, larynx, trachea, bronchi or the lungs interfere more or less with inducing comfortable and successful anæsthesia. At times when the patient does not succumb to the anæsthetic as quickly as usual, showing signs of distress and discomfort, an examination will often disclose hypertrophied turbinated bones; deviated septum; nasal polyp or polypi; enchondroma or osteoma in the nares; adenoma or other growths in the pharynx; cleft palate, hard, soft, or both; odœmatous or elongated uvulva; en-

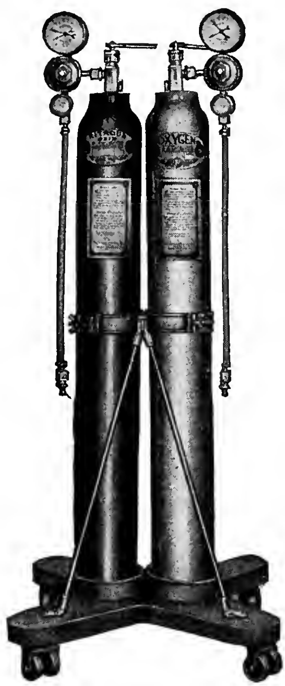
larged tonsils; enlarged thyroid gland; impaired lungs, or lungs restricted in their action by adhesions, the result of former inflammatory affections or the presence of pus cavities or encroachment on the lungs of various enlargements and tumor formations. The anæsthetic itself is not always to blame for imperfect anæsthetization.

When a prolonged anæsthesia is to be induced, the patient must be as carefully prepared as for ether or chloroform. Everything that has been said in regard to the chair, the assistant, the mouth-prop, suggestion, arrrangement of instruments, etc., in the lecture on nitrous oxid is applicable here. All these matters, as insignificant as they may appear to you, must be observed if you wish to be successful in administering nitrous oxid and oxygen for dental purposes.

While a good assistant is essential to success with pure nitrous oxid, with nitrous oxid and oxygen it is imperative. Hundreds of nitrous oxid appliances have been discarded, others literally thrown out of the office by discouraged and often disgusted operators, because of failure to get satisfactory results, the supposed fault not being with either the nitrous oxid and oxygen or with the appliance, but mostly because of lack of intelligent assistance.

All preliminary arrangements having been made, the patient is now ready to be anæsthetized. The "O" bag should be filled almost full of oxygen and the "NO" bag about two-thirds full of nitrous oxid. There should really be considerable tension on these rubber bags, but not enough to explode them. Place the in-

haler over the mouth and nose with the anæsthetic shut off. Have the patient breathe deeply and evenly two or three times to test the valves and to see that the adjustment is such as to exclude all air. You

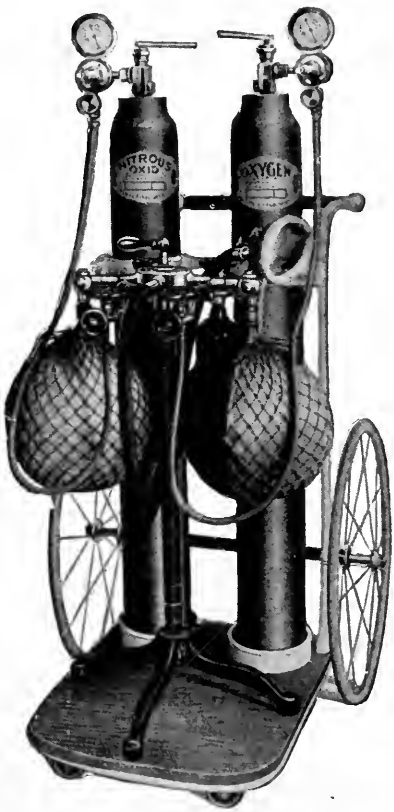


NO. 2 LENNOX STAND.

These cylinders can be placed at some distance from the chair, in another room if desired, and connected with the appliance by means of small rubber tubing.

judge by the sound of the valves as to whether they are in good working order. Satisfied on this point, the anæsthetic may now be admitted. The first few inhalations should be of pure nitrous oxid. As soon as duski-

ness of the face is observed, turn the oxygen indicator to "1" at first, then "2," and as the anæsthesia advances, to "4" or "6" gradually. If you should begin



Clark Appliance, Lennox Carriage, large cylinders with pressure Gauges.

with "6" or "8," the patient would manifest signs of restlessness and excitement.

The frail, the delicate and the anæmic will admit of

oxygen in larger proportion in the beginning than the vigorous, the plethoric and the athletic. With the average patient you can advance the indicator five points in about thirty seconds, and in fifty-nine or sixty seconds to "8." **The indication for more oxygen is the color of the face.** There is no other rule. If the face assumes a dusky hue, the indicator may be advanced still further. In the absence of duskiness and a tendency on the part of the patient to laugh or cry or move the hands and legs, the indicator should be set back a number or two. It is important that the **amount of oxygen in the "O" bag should be equal to the amount of nitrous oxid in the "NO" bag.** If this is not the case, the nitrous oxid will have more force behind it than the oxygen and the proportions can not be maintained. By the use of the larger cylinders equipped with pressure regulators, an equal pressure, and the same number of pounds of pressure for each gas can be obtained. As already mentioned in a previous lecture, there should be no conversation allowed while anæsthetizing the patient. **Sounds are exaggerated, and the sense of hearing remains intact till the close of the third stage and with some patients is not lost. Talking back and forward between the operator and the assistant, "do this and do that," is enough to defeat any anæsthesia. Suggestions to the patient in a low, quiet, but firm tone of voice, looking to the quieting of the patient is the only conversation permissible during the induction of anæsthesia when the assistant is operating the appliance.** If I wish more oxygen, "O" is made with the thumb and first finger; if more nitrous

oxid, two fingers are raised, representing an "N." If I wish the oxygen reduced, an "O" with the fingers and one nod of the head at the same time means set the oxygen indicator back one notch, two nods two notches, etc. An "N" with the nod of the head means a reduction in flow of the gas, two nods a greater reduction. With the new appliances, one lever controls both the nitrous oxid and oxygen supply, and the operator can act as anæsthetist, if he so wishes, until ready to operate. Two persons soon learn to work together with signals as successfully as a base-ball battery. The longer the anæsthesia, the more oxygen will the patient consume as the anæsthesia progresses. Different appliances may vary somewhat. I find about "8" per cent, or rather when the indicator is at "8," I get the best results, on the average, in dental operations.

For a simple case of extraction, say two or three teeth, for which it would require fifty seconds to obtain an available anæsthesia of thirty to thirty-five seconds with pure nitrous oxid, an administration of nitrous oxid and oxygen for a period of about one hundred and ten to one hundred and fifteen seconds, would afford an average available anæsthesia of about forty-five seconds. The patient in the former case, in which pure nitrous oxid was administered, would be cyanotic and on the border line of dangerous asphyxia; in the latter case, enough oxygen would be inhaled to prevent all cyanosis and asphyxial symptoms.

The First Stage of nitrous oxid and oxygen does

not vary materially from the first stage of pure nitrous oxid.

The Second Stage is more prolonged than the second stage of pure nitrous oxid, because the patient does not lose consciousness as quickly. Respiration frequently becomes very rapid and deep, and, if the patient shows signs of excitement, too much oxygen is being inhaled and the amount should be reduced. As anæsthesia deepens, the stertor, incident to the last part of the second stage of nitrous oxid anæsthesia, is replaced by gentle snoring; the dusky cyanotic condition of the pure nitrous oxid stage is wanting and in its place a normal complexion.

The Third Stage, or the Stage of "Surgical Anæsthesia," is the one in which the difference is more marked. Instead of deep cyanosis and loud stertor, the **patient has the appearance of one in a natural sleep,** and even the gentle snoring of the second stage disappears. **The breathing is regular and quiet.** You will remember in the lecture on nitrous oxid that I called your attention to the fact that the tongue became enlarged on account of engorgement of venous blood, and suggested that if the tongue was engorged the same condition must be present in a greater or less degree throughout the respiratory tract. **This swelling of the tongue is markedly less when anæsthesia is induced by nitrous oxid and oxygen,** and, of course, the breathing would be less interrupted, and in case the patient should happen to have adenoids, enlarged tonsils, nasal polypi, etc. (such conditions being very common), **there would not be the same inconvenience and**

danger as would be assumed in administering pure nitrous oxid. In this stage, the pulse is strong, but not as rapid or small as the pulse in the third stage of pure nitrous oxid. It is very much more like the normal pulse, just as the breathing and the complexion is more nearly normal.

The eyelids instead of being rolled back, exposing the eyeballs, are usually closed. The pupils remain more nearly normal than otherwise, and the cornea is generally sensitive to touch, and does not lose its sensitiveness during brief anæsthesias.

The signs of anæsthesia are very much the same as those of chloroform. The arm if raised falls limp. The breathing is usually quiet and regular, and sometimes, by listening closely indistinct snoring may be detected, the degree depending somewhat on the normality or abnormality of the respiratory channel. The conjunctival reflex is lost, and the eyeballs are fixed or may move slightly from side to side, but in a much milder degree than is found in anæsthesia induced by pure nitrous oxid.

The Fourth Stage in nitrous oxid and oxygen anæsthesia is wanting. The toxic dose of this anæsthetic is not known. Only a few deaths have been reported during nitrous oxid and oxygen anæsthesia. I have tried to conceive in what way or by what means death could come under nitrous oxid and oxygen properly administered. Surely not from asphyxia as in pure nitrous oxid narcosis; not from protoplasmic poisoning as with chloroform; not by respiratory paralysis as with ether. For purely dental purposes, eliminating

fright and all physical causes, eliminating a tooth lodging in the trachea, or shock, the result of blood collecting in the throat, both of which are incidental causes only, I cannot conceive of death occurring as the result of administering nitrous oxid and oxygen.

Nitrous Oxid—Oxygen—Carbon Dioxid—Anæsthesia.

Investigations made in the United States the past two or three years by Yandell Henderson and associates of New Haven, Mosso of Turin, and others abroad, have proven beyond doubt that **carbon dioxid is not as formerly supposed a waste product of the body, but that it is one of the body's most important hormones. It exercises a regulative influence on the action of the heart, on the tonus of the blood vessels, and especially upon the respiration. In fact, breathing in ordinary life is practically dependent on the stimulation afforded to the respiratory center by the carbon dioxid brought to it in the blood.** (Ettore Levi, Florence, Italy.) **A discovery of greater importance than this to anæsthetists can hardly be conceived.** After reading Henderson's paper Levi was inspired to experiment with mixtures of carbon dioxid for the purpose of stimulating the bulbar centers in those cases in surgical practice in which, owing to the effects of chloroform and ether or to operative trauma, or to a combination of these causes, the automatic activity of these centers is temporarily paralyzed. The experiments of Levi showed that **in carbon dioxid properly diluted we possess a therapeutic agent of extraordinary potency.** He experimented on animals, inducing failure of the res-

piration by means of the single or combined action of nitrites, chloroform, and morphin. These animals were then made to inhale a mixture of oxygen with various percentages of carbon dioxid—from 10-30%. **In every case there was an almost immediate return of breathing.** He then tried the administration of these gas mixtures to patients who, because of trauma or extensive or prolonged operation, had sunken into a partial or completely comatose state. The effects were at times brilliant, especially in those cases where the breathing had become shallow, or irregular. The most satisfactory results were obtained with a mixture containing 15 per cent of carbon dioxid. In cases where the respiration was decreased (Cheyenne-Stokes type) the periodic rhythm was immediately stopped and normal breathing was not only restored, but continued some time after the inhalation was ended. In such cases not only was respiration improved, but there was a marked improvement in the condition of the circulation. **The disappearance of cyanosis was one of the most striking features.** Burci of Florence has so much faith in the efficacy of this mixture that prior to every operation a gasometer containing a mixture of oxygen and carbon dioxid is prepared, and during the operation is available for immediate use of his assistant administering the anæsthetic. If at any time the patient shows evidences of the slightest tendency to failure of respiratory or cardiac functions, he **administers immediately inhalations of this gas mixture** and does not wait till profound shock or respiratory paralysis is reached. **A rapid return of normal heart action**

and breathing is the almost invariable result. The number of cases thus treated during the past two years at the surgical clinic of the Florentine university now amounts to several hundred. In no case has any ill effects been observed from such treatment. In several traumatic cases in which breathing had entirely stopped, under chloroform anæsthesia, a prompt return to normal breathing occurred. In a case of suicide by hanging, after prolonged artificial respiration, inhalations of oxygen and hypodermic stimulation had not given the slightest results, upon administering the carbon dioxid mixture after a few inhalations spontaneous respiration returned.

A mixture of from 10-15 per cent of carbon dioxid after the completion of an operation is very effective in causing a prompt awakening of the patient. It seems also to tend to decrease post-chloroform vomiting. This is probably because of the rapid elimination of chloroform from the blood and tissues under the influence of the increased respiration induced by carbon dioxid. (An epitome of Levi's paper in Journal A. M. A., March 16, 1912.)

As the result of these experiments of Yandell Henderson and others the entire anæsthetic procedure now in vogue may have to be modified. McKesson of Toledo, and others, were quick to recognize the importance of these discoveries, and immediately set about to construct anæsthetic appliances by which carbon dioxid could be used in connection with nitrous oxid-oxygen anæsthesia, and also with ether and chloro-

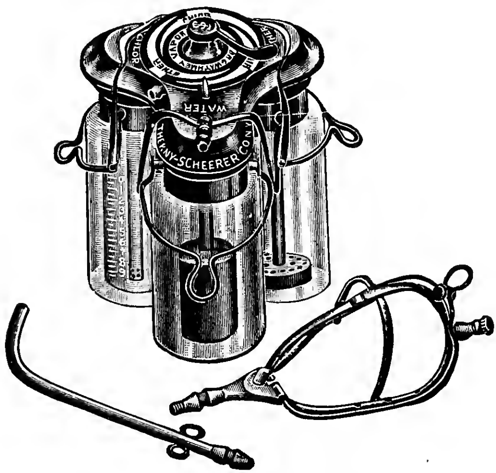
form. A re-breathing chamber or compartment is arranged, so that with each inhalation of nitrous oxid, ether, or chloroform a percentage of carbon dioxid is admitted. In this manner the patient utilizes his own carbon dioxid, and McKesson further shows that this re-breathing procedure results in an actual saving of seventy-three gallons per hour of nitrous oxid, and besides makes the anæsthetic safer. It would seem then, that in the near future, especially in prolonged anæsthesias, the re-breathing method, or the admixture of carbon dioxid independent of what is exhaled, will receive attention and be utilized.

Another step in advance has been scored in that we not only have a safer method of administering anæsthetics, but have gained a most important and potential therapeutic agent for resuscitation of the patient in cases of impaired respiration and circulation during anæsthesia.

It occurs to me, in the light of these new discoveries, that the manufacturers of nitrous oxid and oxygen should also prepare for our use cylinders containing 85% of oxygen and 15% of carbon dioxid, and that everybody administering either local or general anæsthetics procure one of the tanks and have it in readiness in case it was needed.

It also occurs to the writer, that experiments should be made with this combination in various percentages and results carefully studied. If it can be shown that such a combination maintains normal respiration and circulation more surely than oxygen alone, then why

not make such a combination as a substitute for pure oxygen when administering nitrous oxid and oxygen. Such a procedure would be very much easier and far more satisfactory and obviate a special device thus further complicating anæsthetic appliances.



THE GWATHMEY APPLIANCE.

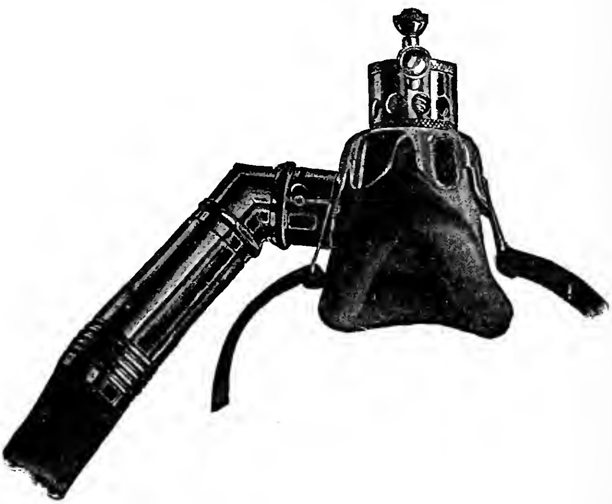
LECTURE XIII.

Nitrous Oxid and Oxygen in Operative Dentistry.

With most dentists, the word anæsthesia is synonymous with extracting teeth. Ask the average dentist if he uses general anæsthetics and he will say, "No, I do not extract more than three or four teeth a month in my practice and have no use for anæsthetics." If anæsthetics meant no more to me than the mere extraction of teeth, I would not have prepared these lectures, I can assure you. The dental surgeon **should use anæsthetics in all painful conditions.** One of our most eminent oral surgeons, Dr. G. V. I. Brown, told me recently, that if he should resume the general practice of dentistry he would use nitrous oxid a thousand times where formerly he had used it but once. The possibilities of this anæsthetic, especially in combination with oxygen, had not been realized until he was called upon to use it so often in his oral surgery practice.

In what class of cases would I use nitrous oxid and oxygen? **In all painful conditions the dentist is called upon to treat: Sensitive cavity preparation; removal of pulps surgically, and sometimes after an arsenical application has been made; shaping teeth for crowns or abutments whether alive or devitalized, for in one**

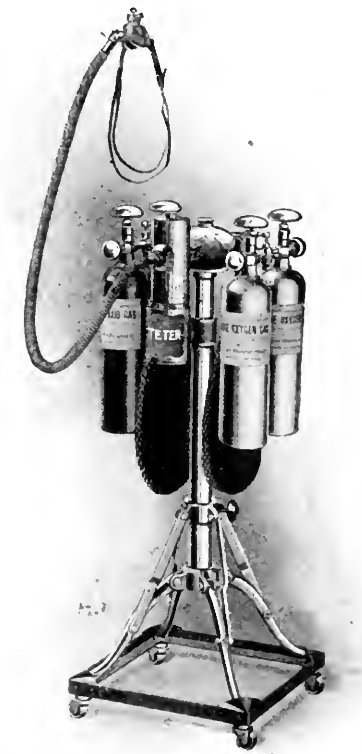
instance they are exquisitely sensitive, in the other the grinding and cutting is more wearing on some patients than a real "hurt"; adjusting cervical or painful clamps; treating pyorrhoea; rapid wedging of the teeth to gain space for filling; opening into teeth affected with pericementitis or acute alveolar abscess; lancing abscesses; opening into pulps for the purpose



THE TETER NASAL INHALER.

of making an arsenical treatment—in short, all painful or fatiguing operations on the teeth. Once familiar with operating under analgesia or anæsthesia you would relinquish dentistry rather than practice as you are now doing. You may think you know, but you do not know the first letter in the word "gratitude," nor will you know till you have looked into the eyes and faces of your patients when they leave the chair after using nitrous oxid and oxygen.

The most sensitive cavities can be prepared, the most painful conditions rendered absolutely painless by this method. It is seldom necessary for the patient to lose consciousness; it is a stage of analgesia rather



THE TETER IMPROVED APPARATUS NO. 2, WITH VAPOR WARMER AND STAND.

than anæsthesia, the patients once in a while momentarily passing into unconsciousness.

Have the patient understand he is not to be hurt, that the whole matter is under his control. Adjust the

rubber dam, insert the mouth-prop, apply the nasal inhaler, as explained in the last lecture. Instruct the patient to raise the hand if he feels pain; keep up a running conversation with the patient like this: "Am I hurting you? Do you feel pain? Do you mind what

The Gregg inhaler consists of a steel bow, padded at each end, extending from the forehead to the base of the skull.

This bow supports the tubing and exhalation valve by means of two small spring clips. The tubing extends from the nares back over the head to the gas apparatus. In order to adjust the appliance simply place bow on the head by opening it, according to size of head, pull tubing forward through spring clip so as to bring it firmly into the nares.

The advantages of the inhaler are:

Its quick adjustment, about ten seconds or less, and perfect comfort when in position.

It does not interfere with operations in the mouth.

Does not depress the upper lip.

Does not suggest smothering by covering the nose, and is very easily kept clean.

I am doing? Are you asleep?" etc., etc. You can keep patients in this condition indefinitely, and they will be resuscitated in two minutes after discontinuing the anæesthetic and leave the office buoyant and happy, not dreading to return for the next appointment. And the operator—that all-gone, all-used-up, collapsed feeling, that five o'clock feeling, is gone to return no more.

The rubber dam adjusted, you need only the nasal inhaler. Instruct the patient to breathe rather deeply the first four or five inhalations, then assume natural breathing. Begin by breaking down enamel walls with a chisel or proceed gently with a bur, the hand to be raised if pain is felt, if the operation is the preparation of a carious tooth. If the patient's face shows the slightest cyanosis, indicate oxygen, and have the assistant admit a little more oxygen; this is usually sufficient, but varies with the individual. Maintain this a while if the patient does not become cyanotic again. If the patient shows a tendency to laugh, or manifests signs of stimulation, diminish or discontinue the oxygen. It is simply a matter now of administering just enough of the combination to get results. If you find the patient going down too deeply, discontinue or diminish the anæsthetic for a few inhalations. You will soon learn the stage in which to operate, by practice.

All that has been said about preparation of the patient is applicable here. A light breakfast or a light lunch must be insisted upon. Loosen all bands, have the corset removed, and the bladder should be empty. When you know in advance that you are to operate

ANÆSTHETIC INDUCTION.

THE DeFORD NITROUS OXID AND OXYGEN INHALER—NASAL.

This inhaler is unique in that it provides a mouth cover which excludes the entrance of air through the mouth while patient is being anæsthetized. When patient is ready for the operation the mouth cover is everted and held up out of the way. All during the operation the patient inhales through the nose, and if signs of resuscitation are noticed before the completion of the operation, the mouth cover is dropped to its position over the mouth, and surgical anæsthesia is quickly induced again. This inhaler is intended to be used with any nitrous oxid appliance.

OPERATING POSITION.

OPERATING POSITION—RUBBER DAM ADJUSTED.

under anæsthesia, the patient can be instructed in regard to loose clothing and dress accordingly. Those who do not insist on these precautions never attain the same degree of success.

An anæsthetic clinic is the most difficult of all clinics in which to get satisfactory results, and those who see anæsthetics administered at clinics only, have little appreciation of what can be accomplished in the quiet of an office with proper surroundings. Everything depends upon the tranquillity of mind that can be induced, and there is little chance for this in a public clinic. If the patient is a woman, the possibilities of saying or doing something improper tends to excitement and restlessness of mind rather than quiet and composure.

One of the most successful public anæsthetic demonstrations I have ever witnessed was conducted by Dr. Jessie Ritchey DeFord, of Des Moines, at the Fourth Annual Alumni Clinic of the College of Dentistry, State University of Iowa, Iowa City, February 4th, 1907. The operator had never operated upon teeth before under anæsthesia. His clinic was to make a porcelain inlay in an upper right cuspid labial surface, gingival cavity. Indeed, this was his first appearance as a clinician. The tooth was so sensitive that the patient could not stand even drying it with absorbent cotton. He objected to taking nitrous oxid and oxygen because, on a previous occasion, he was made very sick from ether. He had three or four other cervical cavities and finally consented to take the anæsthetic under two conditions. The first was that the

preparation of the cavity should be painless, and, second, that all the cavities should be prepared for fillings if he found he was not being hurt. The doctor proceeded with the anæsthetic as I have described, and the patient, a dental student, **at no time lost consciousness,** and when the first cavity preparation was completed said, **"Go on with the next one, I am not being hurt, I am having the time of my life,"** and during the twenty-five minutes consumed in cavity preparation, **he never once raised his hand to indicate he was feeling pain,** and said a dozen times, **"I am not minding it, there is no pain, go ahead."** He made this request, however, "My throat is getting cold, please add more warm water." Here was a patient that had no confidence in the anæsthetic for such operations, and an operator who was naturally embarrassed and timid, having never before operated under an anæsthetic, or even at a clinic, yet the result was, as I have described it, and you can hardly imagine a more trying ordeal for the anæsthetist. The same anæsthetist later in the day induced a thirty-minute anæsthesia at the University Hospital with nitrous oxid and oxygen for an operation on the soft palate performed by Dr. G. V. I. Brown.

LECTURE XIV.

Ethyl Chloride.

Physicians have long sought an anæsthetic agent as quick in its action as nitrous oxid, as free from danger as nitrous oxid, with as little after disturbance, yet one with which a longer period of anæsthesia could be obtained without the cumbersome apparatus incident to nitrous oxid narcosis.

Ethyl chloride when first introduced was supposed to be the long-waited-for agent so devoutly desired. This anæsthetic was first used by Heyfelder, in 1848. In 1880, a committee of the British Medical Association after experimenting on animals, rendered an adverse report, and its use was abandoned. In the year 1895, Carson and Thiesing revived ethyl chloride and it was used to some extent by dentists. This same year Soullier, of Lyons, reported its use in 8,417 clinical cases without a fatality. The first real scientific work, however, is said to have been done by Lotheisen and Ludwig in Prof. von Hacker's clinic in 1897-98.

McCardie, in 1902-03, studied the value of this drug in 620 general narcoses and was enthusiastic in his praise of this agent, claiming that it contains all the requisites of a perfect anæsthetic; and these we find set forth by Tuttle as:

1. Safety.
2. Insensibility to pain.
3. Complete relaxation.
4. Easy and rapid production of effect.
5. Freedom from dangers and disagreeable after-effects.
6. Simplicity of administration.

Tuttle believes, too, that these requisites are nearly all inherent in ethyl chloride. (Montgomery and Bland in **Jour. A. M. A.**, April 2, 1904.) Chemically, ethyl chloride is one of the haloid substitutions derived from ethyl alcohol, and it is formed by the halogen element, chlorine, replacing the hydroxyl group in the alcohol.

Those who claim that the heart's action in the beginning is increased are in the majority. These, however, admit that the circulation returns to normal as soon as anæsthesia is induced, and that this primary disturbance is due to nervous excitement rather than direct influence of the drug, an experience common to the administration of any anæsthetic. While some have sought to show that arterial tension is increased, others are as positive that arterial tension is diminished. I think this difference of opinion has arisen because some investigators have experimented during a light anæsthesia, while other observers have made their observations during deep anæsthesia. Wood found that upon anæsthetizing animals to a deep narcosis the arterial tension was lowered, but, when the anæsthetic was discontinued, the arterial tension regained

the normal; so it is possible that in some of the experiments that have been reported that the narcosis was not deep enough to lower arterial tension.

Koenig not only believes that the arterial tension is lowered in deep ethyl chloride anæsthesia, but says it is due to the influence of the agent on the pneumogastric, because it disappeared after the vagi were cut in animals.

Malherbe and Roubinovich made a test of twenty-four cases with Potain's sphygmomanometer to ascertain the action of ethyl chloride on arterial pressure in man. "Of the twenty-four cases examined by Malherbe and Roubinovich, arterial tension was decreased in twenty-two, and the frequency of the pulse-beats followed equally the modifications in the degree of arterial pressure; during deep sleep diminishing and increasing and attaining finally the normal number as consciousness was restored."

McCardie concludes that the pulse is slower than normal in deep anæsthesia, but that its regularity is maintained.

Montgomery and Bland found that in patients with a normal circulatory apparatus there was usually a slight decrease in arterial tension. There was no decided disturbance in the pulse-beat. At the beginning of the administration, however, there was a certain increase in the frequency of the pulsations, but this, of course, was due to the psychic disturbance of the patient, and not from any direct action of the drug. The respirations were generally stimulated both in frequency and depth.

There is little if any irritation to the respiratory mucous membrane and this is a point well worth remembering, as collection of mucus in the pharynx under ether anæsthesia sometimes almost defeats successful operating. Another feature worthy of mentioning is that the tongue does not swell or increase in size under ethyl chloride anæsthesia as it does under nitrous oxid narcosis.

Unfortunately ethyl chloride narcosis is followed frequently by nausea, and but for this disturbing element would be far more popular and even more extensively used than at present.

Headache is more commonly experienced after an administration of ethyl chloride than after an administration of nitrous oxid gas. Another thing to be remembered is that according to Luke, ethyl chloride has an affinity for the masseter muscle and the spasm is sometimes so severe that it is difficult to find a mouth-prop that will withstand the strain.

Safety.

I consider ethyl chloride, in careful hands, one of the safest of anæsthetics. It, of course, has its limitations, and I think nearly all mortalities reported as result of using this anæsthetic have been due to carelessness, improper administration, or attempting too prolonged an anæsthesia. Most of the mortalities reported have occurred abroad, and you must take into consideration that "abroad" means usually that the "closed" method has been employed, air excluded.

Soullier and Lyons report 8,417 cases without an

adverse symptom. Seitz reports but one death in 16,-000 cases collected by him, and this death occurred in a case in which ethyl chloride was contra-indicated. Ware reports one death in 8,207 cases, and the death was probably the same one reported by Seitz. Mc-Cardie asserted "that it was the safest of all anæsthetics except nitrous oxid, and that the death rate might be placed at one in many hundred thousand." He has since somewhat modified his views, but as late as March 17th, 1906, in **The British Medical Journal,** says: "Fortunately, in an experience of nearly 2,000 cases I have not seen either asphyxia or syncope during its administration." Again, he says: "Since 1897, ethyl chloride has been very rapidly growing in popularity, so much so, indeed, that it has, unfortunately, largely, and in some places altogether replaced nitrous oxid. For instance, in the General Hospital, Birmingham, the latter is rarely used at all save in the dental department. The reasons for this popularity are those that make chloroform so favored: **ethyl chloride is rather pleasant to inhale, is non-irritating to the air-passages, and, more than all, it is most pleasant and easy to administer."**

Weissner states that in Von Hacker's clinic in Innsbruck, that ethyl chloride is used **when ether and chloroform are contra-indicated in high degrees of circulatory interruption, fatty degeneration of the heart, diseases of the respiratory organs, persons enfeebled by great loss of blood and those suffering from nerve shock.**

Luke, of Edinburgh, in his "Guide to Anæsthetics"

says: "In the past two years ethyl chloride has made enormous strides in this country and bids fair to be the most frequently employed anæsthetic which we possess. It has almost completely displaced nitrous oxid in general surgery."

Luke places the death rate at one in 12,000. Lotheison thought ethyl chloride to be "quite harmless," and in April, 1902, reckoned the mortality to be one in 17,000.

Administration.

Ethyl chloride may be obtained in capsules and in tubes. The tubes usually contain about sixty cubic centimeters, but the quantity varies with different manufacturers, and some manufacturers make two or more sizes. The larger tubes are fitted with a spray attachment. These tubes, some of them at least, are graduated so that the amount of material being used for anæsthetic purposes can be seen. For the purposes of general anæsthesia, the ethyl chloride is sprayed from these tubes into an inhaler. The capsules are made of glass and usually contain from three to five cubic centimeters hermetically sealed.

There are a number of inhalers on the market and these are so arranged that ethyl chloride can either be sprayed into the inhaler or one of the capsules fractured and its contents discharged upon a piece of gauze arranged for that purpose. An ethyl chloride inhaler may be improvised by modifying somewhat an Esmarch chloroform inhaler. The Esmarch inhaler, as you will recall, consists of a wire frame

over which is stretched a piece of stockinet or surgeon's gauze, which extends over the edges and is clamped down. Over this surgeon's gauze is stretched a piece of rubber dam. Clamp the rubber dam down with the gauze, and from time to time spray a small quantity of ethyl chloride on the gauze lifting it away from the face just as the patient completes an inhalation. This can be accomplished while the patient is exhaling, and does not interfere seriously with the administration. It takes longer to anæsthetize a patient and more material is used than when employing one of the many inhalers supplied by the dental and surgical dealers.

Both the Stark and DeFord somnoform inhalers are excellent ethyl chloride inhalers. As these appliances and their use are described in the somnoform lecture, it will not be necessary to refer to them in this lecture except by name.

In the administration of ethyl chloride we have the choice of two methods; namely, first, in which all air is excluded, and second, in which various amounts of atmospheric air is admitted to the lungs along with the ethyl chloride.

With breathing a little deeper than normal, in twenty to thirty seconds light anæsthesia is induced. If the patient is large and muscular, after four or five inhalations it is sometimes necessary to add another c. c. At that point where consciousness is lost, "the patient often quits breathing for from five to twenty seconds." About this time, the patient may become stimulated or excited, move the feet and grab at the

bag. Then consciousness is lost, the pupil dilates, the eyeballs roll, and the respiration becomes deeper and slower. At this stage, two or three teeth may be extracted and the patient not feel the pain; affording a working period from twenty to forty seconds. If there is sufficient anæsthetic in the bag, and the patient is permitted to breathe about ten seconds longer, we get a very profound anæsthesia which will last from one hundred to one hundred and twenty seconds. At this time, the corneal reflex is abolished, the face reddens slightly and sometimes perspiration appears on the face. If the anæsthetic is discontinued at the end of the first stage, the **patient awakes suddenly like one coming out of a hypnotic sleep.** In the deeper anæsthesia just described, most patients recover quickly, but there is with all a **dreamy or drowsy stage just before awaking,** and after awaking, with many, **they close their eyes again for a secondary nap of a few seconds. Just before awaking** is the time when **neurotic women** and **alcoholics** make **trouble,** if they are to become excited after the operation. **It is a dangerous procedure to try to forcibly restrain either class mentioned.** Neurotics and alcoholics occasionally become excited going under, but **ordinarily it is just before awaking,** if they make trouble at all, that you must be on your guard. **Do not try to restrain them and you will seldom have trouble.**

Cyanosis is a rare condition during ethyl chloride anæsthesia, and if it should be present, it arises **not from the ethyl chloride** itself, but rather from some

mechanical interference of the respiration, as swallowing the tongue.

In the stage of light anæsthesia, there are seldom any unpleasant or disagreeable after-effects. The patient is awake and entirely himself in about a minute from the time the first inhalation is taken.

Following the second condition described, in which the anæsthesia induced was of a very profound nature, nausea and headache are sometimes present. I am inclined to the view that nausea and headache following the administration of ethyl chloride, when the "close method" is employed, are caused not so much from the ethyl chloride itself, but is rather the result of re-inhaling the contents of the rubber bag.

I dare say if any inhaler be used in exactly the same manner and be held the same length of time over the nose and mouth, and a given number of patients inhale and re-inhale the contents of the bag, without ethyl chloride being added, a certain number of those trying the experiment will experience nausea and headache. Blood entering the stomach nearly always produces nausea. The anæsthetic should not be held responsible for nausea, the result of swallowed blood.

The Stark and DeFord inhalers are so arranged that the amount of anæsthetic and the amount of air entering the lungs can be very accurately gauged. I am an advocate of the open method in administering ethyl chloride, just as I prefer the admission of air freely in the administration of ether, chloroform and somnoform. Take a 3 c. c. capsule of ethyl chloride,

place it in its compartment in the Stark or DeFord inhaler, with the appliance in position, and the patient ready, fracture the tube. For the first two or three inhalations, admit all air, then just a little ethyl chloride, then a little more, then a little more. Now all air may be excluded and the patient permitted to breathe once or twice and usually an available anæsthesia of about ninety seconds can be obtained. You can regulate the depth of the anæsthesia to suit the operation to be performed. Nausea and headache following the administration of ethyl chloride with an admixture of air is less frequent than when all air is excluded. As ethyl chloride is administered in the same kind of an appliance as somnoform and both preparations are sold in the same kind of containers and in the same-sized tubes and capsules, the reader, for a more minute description of the administration of ethyl chloride, is referred to the lecture on administration of somnoform.

As the difficulties and dangers encountered in ethyl chloride administration are also the same as those arising from somnoform anæsthesia, these will be found to be very fully discussed in the somnoform lectures.

LECTURE XV.

Somnoform.

We are indebted to **Dr. G. Rolland,** of Bordeaux, France, for the anæsthetic mixture which he has named **somnoform.** In 1895, Dr. Rolland organized the Bordeaux Dental School, and to him was assigned the chair of anæsthesia. Not being satisfied with the anæsthetics in general use for dental purposes, he experimented with various anæsthetic mixtures till 1899, when he made public the results of his research. He maintained that an ideal anæsthetic should be one that "would enter into, sojourn in, and make its exit from the organism in the same manner that oxygen does; that the tension of the anæsthetic agent should be greater than that of oxygen in order that it might take the place of oxygen in the lung alveoli; and that, according to the laws of the physiology of respiration, tension produces two classes of phenomena which alternate and are opposed to each other, namely, absorption and elimination, and, as the degree of volatility of a gas determines its pressure, the more volatile a gas, the more easily it can be absorbed, and consequently the more easily it can be made to take the place of oxygen."

Just as the red blood corpuscles are charged with oxygen, during inhalation and distributed to the tissues,

so will somnoform be absorbed. It is estimated that it takes about thirty seconds from the time the blood leaves the lungs charged with oxygen until it returns laden with carbon dioxide. A given red corpuscle, then, would have fed out all of its oxygen in about fifteen seconds. Rolland argued that, as the oxygen of the blood is consumed in about fifteen seconds, the ideal anæsthetic should be as rapid in its action, and experimented along that line.

In the chloride of ethyl, we have an anæsthetic agent almost as rapid in its action as somnoform, but no doubt Rolland satisfied himself that this agent was not volatile enough and had too high a death rate. Bromide of ethyl evidently did not meet his approval. This latter agent is not as volatile even as the ethyl chloride. Methyl chloride is more volatile than either of these agents and no doubt is added to the ethyl chloride and the ethyl bromide on account of its rapid evaporation, thus increasing the tension of somnoform and causing it to be more rapidly absorbed and more quickly eliminated. It is said that methyl chloride volatizes at twenty degrees below zero, and it is this agent that makes somnoform so volatile.

Somnoform is composed of

	Old Formula.	New Formula.
Ethyl Chloride	60%	83%
Methyl Chloride	35%	16%
Ethyl Bromide	5%	1%

I am inclined to think that this is a mechanical

mixture rather than a chemical compound. By excluding all air, anæsthesia can be induced in about fifteen seconds. I believe this to be due to the diffusibility of the methyl chloride. The methyl chloride possesses anæsthetic properties of its own, and of the three agents would naturally evaporate quicker than the others, carrying some of their vapor along with it. In the matter of volatility, the ethyl chloride comes next, and serves to prolong the anæsthesia, and the ethyl bromide would naturally evaporate more slowly than the others, maintaining the anæsthesia as the other agents would be more rapidly eliminated.

We know that with nitrous oxid the average induction period is forty-four seconds, and the average available period of anæsthesia is thirty seconds, while with somnoform, when all air is excluded, the induction period is from fifteen to thirty seconds, and the period of available anæsthesia from sixty to three hundred seconds.

I have noticed in using the large somnoform tubes that after two or three anæsthesias have been induced the bromide odor becomes more pronounced, and when nearly empty the odor is almost that of pure ethyl bromide, and it is from this fact that I have come to believe that somnoform is not a chemical compound, but a mechanical mixture, and that each ingredient is inhaled in proportion to its volatility. I do not mean by this that the patient gets at first all or nothing but methyl chloride, then the ethyl chloride, and after these the ethyl bromide, because the methyl chloride no doubt carries some of the vapor of both of these

agents along with it; but I do believe that in a general way, with somnoform, **we get an anæsthesia characteristic of each agent in a modified form.** For instance, there is **less muscular spasm** during somnoform anæsthesia than in the anæsthesia induced by ethyl chloride; there is **less nausea** following somnoform anæsthesia than with ethyl chloride or ethyl bromide alone; somnoform anæsthesia is **more tranquil than ethyl chloride** anæsthesia, somnoform anæsthesia **is superior in every respect to the anæsthesia induced by either ethyl bromide or ethyl chloride.**

As to safety, somnoform outclasses both ethyl chloride and ethyl bromide, and it is difficult to explain why there should be such a discrepancy in the mortalities incident to these anæsthetics. Ethyl chloride and ethyl bromide **are administered almost universally by physicians and professional anæsthetists,** the patient having been prepared in advance; **while somnoform has been administered mostly by dentists,** many of them purchasing appliances and administering it without any experience whatever. Dental salesmen were sent out from almost every dental depot in the United States, and actually instructed dentists in the use of somnoform; many of these salesmen, prior to this, had never seen an anæsthetic administered; yet, when you compare the death rate of these anæsthetics, two being administered almost entirely by physicians and professional anæsthetists, and the other by inexperienced dentists and traveling salesmen, the results obtained are almost beyond belief. The death rate of ethyl chloride is estimated at about one in twelve thousand.

The death rate of ethyl bromide is one in about five thousand administrations. Combining these two anæsthetics with methyl chloride in the proportions mentioned we have somnoform, with a mortality of about six in two million administrations.

It might almost seem that I must be mistaken in saying that somnoform is a mechanical mixture, but rather that it is a chemical compound, the safety of which is infinitely greater than the safety of its constituent parts. I have been asked hundreds of times if I considered somnoform as safe as nitrous oxid gas. This is rather a difficult question to answer. The answer can not be given "yes" or "no" without going somewhat into details. If all air is excluded in administering nitrous oxid gas, Hewitt says, the average time in which dangerous asphyxia is produced is fifty-six seconds. This, he also says, is the average time of complete anæsthesia. It is not true of any other anæsthetic with which I am acquainted, that the stage of surgical anæsthesia and the danger point is the same. We are always in danger, then, with nitrous oxid, according to Hewitt, when the patient is surgically anæsthetized. But, before we reach this point with nitrous oxid, the distress of the patient is so great and the symptoms so alarming, that few men are brave enough to really anæsthetize their patients and operations are nearly always performed before surgical anæsthesia is induced, and this is the reason that so many fail with nitrous oxid gas. The patient feels and knows everything that is done, because he is not surgically anæsthetized. Most operations under nitrous oxid

are performed in the analgesic rather than the anæsthetic stage, and a large number are absolute failures, and it would have been better for both the patient and the operator, had nitrous oxid not been administered. Discredit is brought upon a good anæsthetic and often upon a good appliance by attempting extraction and surgical operations when the patient is not surgically anæsthetized. I say without hesitancy, that I consider the stage of surgical anæsthesia induced by pure nitrous oxid as dangerous, and even more so, than the stage of surgical anæsthesia induced by somnoform. I will also add that, if from fear you stop short of the stage of anæsthesia with somnoform, as is nearly always done with nitrous oxid, you can accomplish as much again with somnoform as with nitrous oxid and not hurt your patient or have them struggle and resist as they do under nitrous oxid.

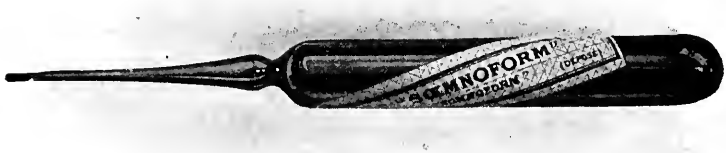
There is this to say in favor of nitrous oxid, that the "leave-off" symptoms are very pronounced, while with somnoform this is not the case. There is no cyanosis, no jactitation, no rolling of the eyeballs or stertorous breathing, but a beautiful tranquil sleep in most cases and nothing alarming to either the anæsthetist or any friend that may be present. Approaching anæsthesia can always be told when somnoform is the anæsthetic employed, as surely as when nitrous oxid is used; but when surgical anæsthesia is induced with somnoform, the patient is in a condition of safety, while, when the stage of surgical anæsthesia is reached under pure nitrous oxid, the patient is dangerously asphyxiated.

You can produce death with these anæsthetics by

holding the inhaler tightly over the nose and face, excluding all air, but with proper precautions and careful watching death rarely occurs under any anæsthetic. In more than six thousand somnoform anæsthesias, I have never witnessed an alarming or dangerous symptom.

Somnoform is a transparent liquid preparation ready for use, in glass tubes and capsules, sold by all dental dealers, the tubes contain sixty grammes, while the capsules are made in two sizes, one containing 3 cubic centimeters and the other 5 cubic centimeters. To the tubes or bottles is attached a valve by means of which the somnoform is sprayed into the inhaler. These tubes have a centimeter scale on the side and the distance from one division line to the other contains 5 c. c. In spraying into the inhaler, the tube is turned valve end down and held in a perpendicular position. As soon as the somnoform steadies itself, you note its position on the scale; it settles in the bottle as it is sprayed out. It only took the contents of two of these tubes to convince me that the capsules must be preferable. Unless the entire contents of one of these tubes is used in a short time, the unused portion has a peculiar odor, and the longer it remains in the tube the more offensive it becomes. I thought at first that the materials forming this mixture had decomposed, but later it occurred to me that the valve no doubt leaked a little and that the more volatile constituents of the somnoform were evaporating leaving the heavier bromine proportion. This, I am satisfied, is exactly what happens to the contents of the 60-gramme tubes. Upon in-

quiry I have ascertained that those dentists who complain most about somnoform producing nausea have been using the large tubes.



A SOMNOFORM CAPSULE.

BOX HOLDING TWELVE CAPSULES.

Luke says that ethyl bromide used as an anæsthetic is followed by nausea in forty-five per cent. of the administrations made.

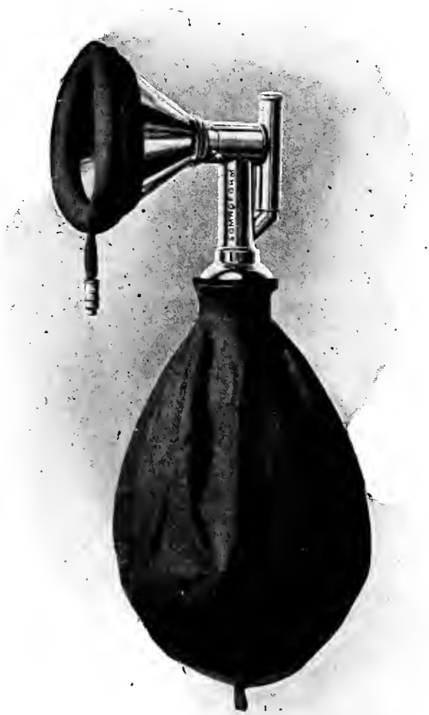
The capsules are hermetically sealed, there is no opportunity for leakage or decomposition and we always know the exact quantity with which we have to deal. For a period of three years, I confined myself to the use of the 5 c. c. capsules, taking it for granted that with that amount of somnoform I could get a better result than by using the smaller size.

On one occasion my dealer being out of 5's, I purchased 3's and have used them almost entirely ever since. Even with the 3's I am confident that not more than half of the contents of these smaller tubes are used, and I find myself wishing that the manufacturers would make a tube containing but two cubic centimeters.

The Stark Inhaler.

The Stark inhaler may be said to consist of three parts. The face-piece is made of metal instead of celluloid and this permits of its being boiled before and after use just as any other surgical appliance. Inside of the Stark metal face-piece is soldered a piece of metal gauze. When somnoform is to be followed by ether or chloroform, a piece of surgeon's gauze is placed in the face-piece on the metal gauze. As soon as the patient is deeply anæsthetized with somnoform, the face-piece is detached from the appliance and now becomes an ether or chloroform inhaler, the drop method being employed. The change can be made in the fraction of a second and the ether or chloroform simply dropped on the surgeon's gauze. In the hori-

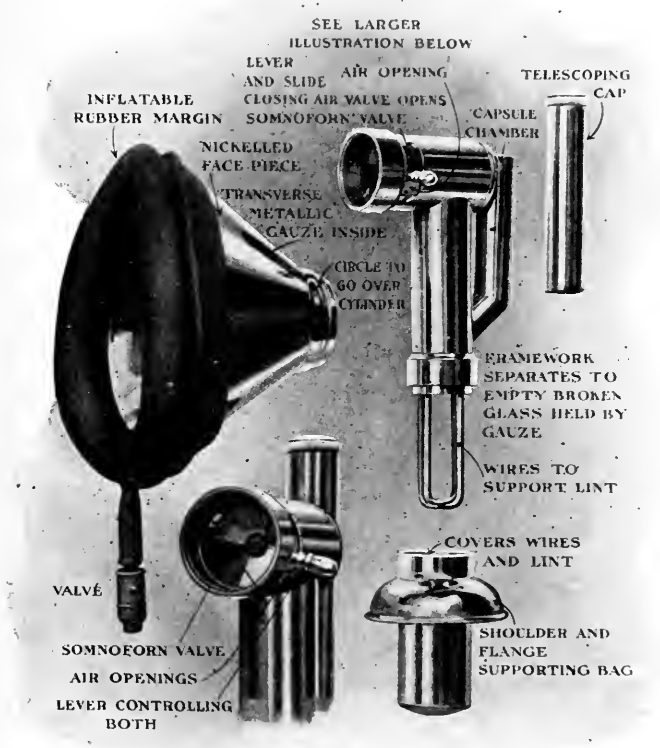
zontal tube is an opening on each side for the admission of air. Just back of these openings is a device for regulating both the amount of air and the amount of somnoform that shall be inhaled by the patient. This



STARK SOMNOFORM INHALER.

device is regulated by means of a small handle or lever moved backward or forward by the thumb of the hand that holds the inhaler. By means of this simple device the amount of somnoform inhaled can be regulated to

a certainty. If you so wish, all of the somnoform can be excluded and only air admitted. The patient with



DETAILED CONSTRUCTION OF STARK SOMNOFORM INHALER.

the inhaler in position, can breathe for any length of time desired without getting so much as a trace of the

anæsthetic. You can admit just an odor, at first, and increase it as slowly or as rapidly as you desire for each individual case. The amount of anæsthetic inhaled is absolutely under your own control. More than this, when the patient is anæsthetized, the somnoform can be shut in, its escape prevented, and again turned on at the desired time. I have fractured a 5 c. c. tube of somnoform in my Stark appliance, and thirty minutes later found sufficient remaining in the bag to anæsthetize a patient.

On the back of the perpendicular tube is soldered a smaller brass tube just the size to hold a 5 c. c. capsule of somnoform. Of course, if it holds a 5, it will also hold a 3 c. c. capsule, but not at the same time. The capsule in position, the cover, another brass tube telescopes over the capsule, and when the patient is ready, slight pressure on the telescoping tube fractures the capsule and the contents collect on the absorbent lint, or surgeon's gauze, in a receptacle beneath made for the purpose. A rubber bag is attached to the lower part of the appliance to prevent the somnoform escaping after being liberated from its capsule.

A special appliance is necessary for somnoform on account of its volatile nature. After once leaving its capsule, it evaporates so rapidly that it is impossible to confine it in any appliance without a rubber bag. On one occasion I went with an oculist to the residence of a patient to administer somnoform for an eye enucleation. Upon arriving, I discovered that I had failed to bring the rubber bag. We tried first, holding a napkin over the bottom of the appliance where the bag is

attached and wasted four or five 5 c. c. capsules. Then we tried cotton underneath and a napkin over that and wasted two or three more 5's and gave up in disgust. The next day we returned and with one 3 c. c. capsule induced an anæsthesia sufficient for the enucleation, and, when the patient returned to consciousness the bandage was in position, the last pin just being inserted.

Ethyl chloride can be administered without a bag; so can ethyl bromide, but somnoform must be contained. If you will take a 3 c. c. capsule of somnoform and hold it a little higher than the head and fracture the point by striking it, the fluid will not hit the floor; it will vaporize before it gets that far.

The DeFord Somnoform Appliance.

The DeFord Somnoform Appliance is a modification of and an improvement on the Stark Inhaler. It provides a means of continuing somnoform inhalation after the patient is ready to be operated on in operations in and about the mouth, nose and eyes. In all such operation the Stark inhaler must be removed from the face when the surgeon begins to operate, but the DeFord Appliance makes it possible to induce continuous anæsthesia while operating, as is done under nitrous oxid and oxygen anæsthesia. Provision is also made to continue the somnoform anæsthesia if desired by the use of ether or chloroform without removing the appliance from its position on the face.

The appliance is strapped on the head in the same manner as a nasal inhaler for nitrous oxid and oxy-

gen. By means of a metal rod a mouth piece is attached to the nasal inhaler. With the mouth propped open wide, the mouth cover is adjusted in proper relation to the nasal inhaler, covering the mouth, and fas-

ANÆSTHESIA INDUCTION—DEFORD SOMNOFORM APPARATUS.

tened tight to the rod by a set screw. When the patient is anæsthetized the mouth cover is everted and is held up out of the way of the operator by a holding device attached to the nasal piece. If patient shows

OPERATING POSITION—DeFORD SOMNOFORM APPARATUS.

OPERATING POSITION—RUBBER DAM ADJUSTED.

signs of regaining consciousness, this mouth cover can be dropped into its former position over the mouth, excluding the air, and only two or three inhalations are necessary to reinduce anæsthesia. On top and a little to one side is an exhalation valve. By a half turn of the thumb and finger this valve can easily be opened or closed. When open the exhalation of the patient escapes; when closed it aids in rebreathing. A soft rubber rim is attached to the nasal piece, making a closer face adaptation and the appliance more comfortable. On the sides are metal buttons for the attachment of a strap or elastic for fastening the appliance to the head. This part of the appliance is identical with the DeFord Nitrous Oxid Inhaler.

At the place where the rubber tubing would be attached to the inhaler, if nitrous oxid was going to be used, is fastened a metal tube in which is soldered a valve for regulating the amount of anæsthetic and amount of air. This valve is in plain sight of the operator so he can see at all times the adjustment, whether the operation be that of extracting or sensitive cavity preparation. When the mouth cover is everted no matter what may be the operation, somnoform can be inhaled all during the operation through the nasal inhaler. Breathing once established through the nose is apt to continue after the mouth cover is everted. If this should not maintain anæsthesia sufficiently profound, drop the mouth cover as occasion demands.

A rubber tube leads from the valve to the breaking device. The tubing passes up over the head and the rubber bag hangs down back of the head out

of the way of the hand of the patient if he should attempt to grab the bag.

A somnoform capsule is placed in the breaking device and fractured by pressing the telescoping top. Gauze or cotton is placed in the anæsthetic chamber which takes up the liberated somnoform. In this breaking device can be dropped ether or chloroform to be used in connection with somnoform, or used in sequence. On the bottom of the anæsthetic chamber is fastened a rubber bag for confining the anæsthetic vapors.

For operations on teeth other than extracting, the rubber dam being adjusted, the mouth cover can be instantanously removed, simply sliding over a metal pin to the left. When rubber dam is not used, the mouth cover can be retained in position and dropped down over the mouth for an inhalation or two, as needed.

LECTURE XVI.

Somnoform—Continued.

Other things being equal, the anæsthetic that disturbs physiological functions the least must be a desirable anæsthetic. The anæsthetic agent that maintains the pulse rate near the normal, that interferes but slightly with respiration, that does not accumulate in the system, that does not alter the secretions of the kidneys, that does not change the blood chemically, that seldom nauseates, is rarely followed by headache or unpleasant after-results, and, in addition; one that quickly anæsthetizes and is quickly eliminated and not difficult to administer is, indeed, an anæsthetic worthy of investigation. Such an anæsthetic is somnoform.

A patient about to be anæsthetized, no matter how trivial the operation, or how safe the anæsthetic agent employed, is more or less nervous and excited. It is seldom that a patient takes the dental chair to be anæsthetized that he does not have an accelerated pulse. Physicians, accompanying patients to my office to witness an extraction under somnoform anæsthesia, have frequently called attention to the fact that a pulse of 150 or higher, at the beginning of the administration, falls to about 80 or 85 and is maintained at that during the operation. In other patients, the pulse may not beat

more than 90 per minute upon taking the chair, but usually quiets down to a little above normal. While somnoform, no doubt, increases the heart's action at the beginning of the anæsthesia, I am inclined to believe that a **pronounced acceleration is the result of nervousness and anxiety** on the part of the patient. It is no unusual occurrence for the pulse to increase its action perceptibly and sometimes disastrously during an examination for life insurance, even when no heart abnormality is present.

There are a few patients who maintain their nervous equilibrium to such a degree as not to show excitement when about to be anæsthetized. The pulse, in these exceptional cases, under somnoform, in the beginning, is usually augmented ten to fifteen beats per minute, but when completely anæsthetized resumes the normal, or just a little above the normal.

My experience with somnoform has shown the pulse to be **more of an ether than a chloroform pulse;** full, bounding and regular. Somnoform **is eliminated** quickly, the patient being **slightly stimulated, wonderfully pleased, talkative and buoyant.** Even quiet people talk fluently, and talkative patients for several minutes will repeat time and again their dream or experience during anæsthesia, **amazed and delighted at the result obtained.** I recall the case of an attorney for whom I extracted a third molar. He was a large man, weighing, I should say, more than two hundred and fifty pounds. I operated for this man at about 11 A. M., and I never had a more pleased patient in my life. **About 1 o'clock**, he returned to the office and said:

"I wish again to thank you for the operation you made for me this morning, and I wish that you would show me that appliance; I want to know just how it works." This is only one instance of the appreciation shown by nearly everyone for whom I have operated under somnoform. I think I may safely say that ninety-five per cent. of the patients to whom I have administered somnoform **regain consciousness in a state of comfortable or joyous stimulation.** They can not thank you often enough and they volunteer to send all their friends and neighbors. I recall a fine old gentleman past seventy-five years of age. I extracted seven teeth for him under somnoform anæsthesia, and he ran his hand into his pocket and paid the fee before he left the chair. He remarked that his daughter had suffered for years with her teeth, and he would have her pay me a visit. The next day she arrived. She remarked, "Father drove home from your office, alone, thirteen miles, after you operated for him, put his horse in the stable and came direct to my home, before going into his house, to tell me about it"—another example of somnoform stimulation.

Rarely does anyone become exhausted unless over-anæsthetized, as the result of somnoform anæsthesia. I have had, perhaps, a dozen cases in which I allowed the patient to rest a few minutes before leaving the office. In each of these cases, I administered **more somnoform than necessary,** or the patient was more than ordinarily susceptible to its influence.

The respiration at the beginning of somnoform induction is usually what the anæsthetist makes it. By

this I mean that the patient tries to breathe as instructed. **I say nothing about the breathing** until I ascertain by observation the respiration of the patient. Very seldom is it necessary to make any suggestion in regard to respiration. By giving directions in advance, the **patient becomes confused and alarmed and breathes every way but the way you desire.** Say nothing and you will succeed far better than by giving the minutest instruction.

Ordinary respiration is sufficient to oxygenate the blood, and ordinary respiration is sufficient to somnoform the blood. After the appliance is adjusted, if the patient continues to breathe normally, in a few seconds the respiration will become deeper and slower. Should this occur there is no need for alarm, it is physiological with somnoform. Should the patient after the first few inhalations begin to take shorter and shorter breaths, amounting almost to "panting," in a low, firm voice **suggest deeper breathing.** If short respiration is continued, remove the inhaler, or shut off all somnoform until normal breathing is resumed. With the kind of breathing described, the patient is **more apt to become asphyxiated than anæsthetized,** no matter what anæsthetic agent is employed.

When I procured my first somnoform appliance, I studied the directions for three weeks before making an administration. My first patient was an athletic young fellow, a foot-ball player, who, in a practice game, fractured his left central and lateral incisors, the pulps remaining in position. The directions that came with the somnoform appliance, said, "Instruct the patient to

breathe deeply, and when the first exhalation passes into the rubber bag, break the capsule and exclude all air." As I had administered nitrous oxid for more than twenty years, I thought I knew what deep breathing meant, so I showed my patient in advance how I wished him to breathe. He did just as I told him. The first inhalation he received all air, and no anæsthetic; on the second inhalation the air was excluded from the appliance and he received all somnoform with the air he had exhaled into the bag. His head fell to one side like he had been hit with a black-jack. I removed the pulps and then took out my watch and timed him. His pulse was strong, his respiration a little deeper than normal, and he slept as quietly and as peacefully as a child for the period of six minutes. The same afternoon a girl, fourteen years of age, presented with the lower sixth year molars on each side broken down. I instructed her to breathe about half as deeply as the young man, and allowed her to take three inhalations with all air excluded, extracted the teeth and could have removed others. After a while I learned that **deep breathing was not essential to somnoform anæsthesia,** and at the present time, as intimated above, **prefer normal breathing** in nearly all cases.

Occasionally a nervous child or a hysterical woman, at the very beginning of somnoform induction, **will hold their breath and refuse to breathe.** The longer the breath is held, the deeper will be the next inhalation. It is important just here to watch closely. The inhaler should be removed or the valve closed, pre-

venting the somnoform from escaping, as it **would be dangerous to inhale pure somnoform at the next inhalation.** You will recall that many patients die when chloroform is administered when only two or three inhalations have been taken. **The vapor was too strong or the inhalations too deep.**

It is evident that **somnoform does not accumulate in the system,** because the patient recovers consciousness very quickly no matter how long the anæsthetic state is maintained. My longest somnoform anæsthesia lasted twenty-five minutes, and in a minute after removing the inhaler the patient was wide awake. This was a case of crushed fingers. The surgeon thought five minutes would be ample for the operation, but the case proved to be more complicated than at first supposed. At the end of five minutes I suggested ether, or chloroform, but there was neither in the office of the physician, and the operation would have been discontinued if either of us went to a drug-store, so there was nothing to do but continue with somnoform. I used ten 5 c. c. tubes, and the patient left the office in less than three minutes after the anæsthetic was discontinued.

Dr. Bronson, a dentist residing at Gowrie, Iowa, told me that he anæsthetized his sister-in-law with somnoform for a surgical operation, and maintained **surgical anæsthesia for thirty-five minutes.** I had an opportunity to talk with the patient and had her give me a history of the case. She had, on previous occasions, been anæsthetized with both ether and chloroform and was in a position to make a comparison. She

informed me that the somnoform anæsthesia was in no way unpleasant and that she awoke just as she did mornings from natural sleep. She felt no pain whatever during the operation. There was no nausea, such as she had experienced with ether and chloroform. The anæsthetist told me he had hardly removed the inhaler when she was wide awake. I mention these cases to show that somnoform is not cumulative in the sense that ether and chloroform are cumulative. I have had brought to my notice a few cases where patients were drowsy and wanted to sleep after the operation. This is common to chloroform and ether, but seldom occurs as a sequence to nitrous oxid and somnoform. Hewitt, however, mentions a case, reported to him by a physician, of a patient who slept for three days after an anæsthesia induced by nitrous oxid gas.

Dudley Buxton, the English anæsthetist, says, "Dr. Swain has examined the blood of patients before and after taking somnoform and found no change in the amount of hæmoglobin or in the number of leucocytes.

Urinary analyses have been made prior to and at the conclusion of somnoform anæsthesia and no alteration in the specific gravity or nature of the urine has been observed. [Buxton.]

Somnoform, so far as I have been able to observe, does not irritate the mucous membrane; nor does it irritate the nerves of the nares, pharynx, larynx, trachea, bronchi or lungs. Its non-irritability is an element of safety well worth mentioning. From the fact that it does not irritate the mucous membrane, there is an absence of accumulation of mucus in the throat,

such as we always have accompanying the administration of ether. This **mucus sometimes almost defeats surgical anæsthesia,** and the anæsthetist must discontinue frequently and swab out the throat to prevent suffocation.

From the fact that somnoform does not irritate the nerves, we **can almost eliminate** the condition known as **Laryngo Reflex,** "Syncope of Duret." Irritating anæsthetic vapors sometimes reflexly cause paralysis of the respiration and circulation, which has already been considered in a previous lecture under "Spasm of the Glottis."

From the fact that somnoform is **non-irritating to the respiratory apparatus,** it is indicated especially in minor surgical operations, and for all patients afflicted with pulmonary disorders.

Nitrous oxid causes enlargement of the tongue and the soft tissues of the pharynx and throat from venous engorgement. Patients having hypertrophied tonsils, adenoid vegetations in the upper pharynx, enlarged or œdematous uvula or abnormal growths or neoplasms of the throat are far more comfortably anæsthetized with somnoform than nitrous oxid. Nitrous oxid increases the size of all these tissues, already abnormally enlarged, while there is **no change in the size of the tissues** or organs named when somnoform is the anæsthetic agent used.

Nausea is not a very common occurrence during or following somnoform anæsthesia. Rolland claims but one per cent. of nausea.

I can well understand why some anæsthetists have

more nausea than others. Nausea depends mostly on three conditions: First, administering an anæsthetic on a full stomach, or too soon after eating. This cause I will eliminate, because, as dental surgeons operate largely for patients under nitrous oxid and somnoform just when they happen to come to the office, one dentist is as apt to get patients of this kind as another. Second, some operators insist on a **deeper somnoform anæsthesia** than necessary. **This is a mistake that most men make with somnoform**; they **anæsthetize their patients deeper than is necessary**, usually, for the operation to be performed. Where but one or two teeth are to be extracted, an anæsthesia is induced **sufficient for double the amount of** work to be done. This fallacy can be corrected only by experience. It is more common to those accustomed to administering nitrous oxid gas than to those who have not had nitrous oxid experience. The nitrous oxid man has acquired the habit of **strenuously excluding all air and having the patient breathe deeply.** The habit is so fixed it is difficult to modify it. Then, the nitrous oxid man has been accustomed to such pronounced "leave-off" symptoms, dusky countenance and cyanosis, loud stertorous breathing, jactitation, etc., that it takes him some time to **recognize the less pronounced somnoform anæsthesia indications. Over-anæsthetization**, I think is the most common cause of nausea. Third, **exclusion of all air is provocative of nausea, also.** When somnoform was first introduced into this country, the directions advocated that only one inhalation of air be taken, then to exclude all air and breathe deeply. Two

administrations following the directions convinced me that **a safer and more rational method should be adopted** of inducing somnoform anæsthesia, and, from that day to this, **I have been advocating more air and normal,** or **just a little more pronounced than normal breathing.**

I have already referred to nausea following the administration of somnoform from a partially used 60-gramme bottle. In my own practice, **nausea is a rare occurrence.** In more than 6,000 somnoform anæsthesias I have experienced only about a dozen **cases of nausea where blood was not swallowed.** This record is not confined to somnoform anæsthesias for the extraction of teeth alone, but includes somnoform administration for removal of tonsils, amputation of fingers, ingrowing toe nails, opening abscesses, lancing felons, vaginal and uterine operations, and for various minor surgical cases. **Indeed, I cannot recall nausea in a single instance of somnoform anæsthesia, for conditions other than extraction of teeth and nose and throat operations.**

I recall an interesting case at the Methodist Hospital. One of our leading surgeons called upon me to "guarantee" that I could administer somnoform to one of his patients without supervening nausea. This patient had been recently operated upon and had been so badly nauseated with ether that severe vomiting had made it necessary to remove the stitches, re-open the wound for re-examination and reparation of damages. He insisted that it would not do to have this patient nauseated again. I told him I could promise

nothing in such a case, but was confident that somnoform would be less apt to nauseate than any other anæsthetic. He thought that a five-minute anæsthesia would be sufficient. In this case, the lightest anæsthesia possible for comfortable operating was decided upon. I asked one of the nurses to take the patient's hand, and, when the patient's hand lost its grip or relaxed, to follow the movements of the hand with her disengaged hand. When the nurse's hand started to close, I knew that the patient needed more anæsthetic and when the nurse's hand was relaxed, I knew that the patient's hand was relaxed, so I admitted air. The patient's hand was under the sheet where I could not observe it. With this test for surgical anæsthesia, I held the patient under somnoform anæsthesia for a period of nine minutes, and I learned afterwards there was no supervening nausea.

Just recently a young girl about nineteen years of age was referred to me for an extraction under somnoform anæsthesia. Her mother told me that she would surely become nauseated, that even the smell of meat broiling would make her sick, and that odors agreeable to other people would nauseate her. Of course, I expected nausea, but suggested all during the induction of anæsthesia that she would not be sick, and she was not.

An elderly lady insisted that somnoform would nauseate her, and I insisted that it would not. Then she told me that on a previous occasion she suffered for five days with nausea after an ether anæsthesia, and that the physician despaired of her life. After

regaining consciousness she swallowed a little air and belched it up, but did not succeed in emptying her stomach. I said to her, "There is no use trying; you can't, and you know that you can't." She replied, "I guess I can't." I 'phoned her in the afternoon and ascertained that she had not been the least bit nauseated after returning home.

I could relate dozens of similar cases and these have convinced me that somnoform carefully administered with an abundance of air seldom, if ever, nauseates.

Blood swallowed nearly always produces nausea, and many cases of nausea during or after somnoform anæsthesia, in operations about the nose, throat and mouth, are caused, not from the anæsthetic, but from the blood that gravitates into the stomach.

Headache, with me, following somnoform anæsthesia, is so rare that it is hardly worth mentioning. I have only known three or four patients to complain of headache after somnoform anæsthesia. If others have more of these cases, they probably arise from rebreathing with the air excluded.

LECTURE XVII.

Somnoform Administration.

It would be irksome to repeat here what I have said in a previous lecture about the preparation of the patient, the operating-chair, the assistant, the quiet of the room, etc., yet all these things are taken for granted in what I shall have to say about administering somnoform. If the lecture, "Elements of Success," has not been read, let me suggest that this lecture be deferred till then, because what I am to say now about administering somnoform can not be successfully accomplished unless the details already referred to be minutely followed.

There are several ways of administering somnoform, well illustrated by the following narrative. I gave a clinic May, 1907, before the Nebraska State Dental Society, at Lincoln. A gentleman in the audience evidently thought that his method of administering somnoform was superior to mine, because he asked me if I would permit him to administer somnoform if he procured a patient. I readily consented. He went to the hotel and returned with a traveling salesman of Jewish nationality. He could not have selected a much more difficult case. The patient was an amusing fellow and persisted in giving a history of the case in spite of all we could do to keep him quiet. He claimed

to live in San Antonio, Texas, and said that he had been in every dental office in Texas to have that tooth extracted and he had never met a man before who would even try to extract it; that **his tooth was well known in Texas** and they all advised against having it out. Examination showed the tooth to be an unerupted upper left cuspid. I did not think that somnoform was the anæsthetic indicated for this case. Had it come to me in private practice, the patient would have been sent to the hospital and ether administered. The patient was made ready and the mouth-prop inserted. The inhaler used was the de Trey. The operator placed the inhaler over the nose and face of the patient, then took from the box a 5 c. c. capsule of somnoform and placed it in the aperture made for that purpose. Then he started his patient **breathing as deeply as you ever saw any one breathe** in your life, and after he was breathing rythmically, just as he exhaled, the dentist **fractured the somnoform capsule and excluded all air.** I said to the gentleman next to me, "In about a minute you will see something interesting." In less than a minute the patient's feet were in the air, he knocked the inhaler out of the doctor's hands, and several held him in the chair. The doctor was about to begin operating when I grabbed his wrist and asked him to wait a moment. I assembled the appliance which in the skirmish had fallen to pieces, and placed it over his face again, and continued the anæsthetic. In the meantime **he had taken several inhalations of air, was breathing about normally and took the somnoform without a struggle or the twitching of**

a muscle of his face and I put him down very deep on account of the nature of the operation. By this time the doctor was calm again and in about two minutes successfully extracted the tooth, and the patient opened his eyes laughing and thought he was at the hotel riding in the elevator. He went over to the hotel, wrote out a description of the case, related his anæsthetic experience, subjectively commended the anæsthetist and the operator and insisted that the Nebraska State Dental Society should send a letter of greeting to the Texas State Dental Society and inform them that his tooth had been captured.

This method was new to me, and it may have been a good one, but we came very nearly having a double failure. When the doctor commenced to operate the first time, the patient was not surgically anæsthetized and had he attempted or continued to extract at the time I requested him to wait, he would have failed to have made a successful extraction, and the anæsthesia would have proven a decided failure, and we would have had a rough house. I say the method was a new one. The new feature was to place the capsule in its aperture and have it remain there, the inner barrel being held forward with the thumb. The deep breathing and shutting off all air after the rubber bag had been inflated was adhering strictly to the directions furnished with somnoform appliances when first used in America. It is amazing that more deaths have not occurred from somnoform, and the only thing that has prevented them is the remarkable safety of the anæsthetic.

Somnoform is the easiest of all anæsthetics to administer. In an experience of some eight years, and more than six thousand anæsthesias, **I have not witnessed an alarming or dangerous symptom.** No absolute rule can be formulated to cover all cases in administering an anæsthetic, as **the personal equation must be taken into consideration,** no matter what anæsthetic agent is employed. It is a difficult matter to explain on paper how to administer an anæsthetic. It is an easy matter when I have a patient in the chair, because the method is adapted to that particular case and those looking on grasp the situation, or, if they do not grasp the situation or understand why the details vary with individual cases, it can be explained at the close of the anæsthesia.

In order to simplify matters, let us say that the patient to be anæsthetized is a woman about thirty years of age, of delicate appearance, weighing about 130 pounds, **anæmic,** of quiet demeanor, the operation being the extraction of an upper third molar. The tooth is not a very difficult one to extract. We have said that the **patient is anæmic,** and this is the keynote to this case. You can anæsthetize an anæmic patient a little more rapidly than a plethoric patient without discomfort.

Exclusion of Air.—When somnoform was first introduced the more common method in a case of this kind was to exclude all air or nearly all air. The patient is seated in the chair, mouth-prop in position. She is instructed to breathe rather deeply. Fracture the somnoform tube before adjusting the inhaler. If

the capsule is fractured when the inhaler is in position on the face, the report is apt to startle the patient. The patient is still breathing as described. Place the inhaler again over the nose and face, just as she begins to exhale, and that exhalation will go into and inflate the bag. The valve is so adjusted that the patient gets about one-third somnoform and two-thirds air. Or all air can be excluded and patient then inhales pure somnoform with only the air which was exhaled into the bag. With a 3 c. c. capsule it only requires about three or four inhalations to induce a sufficiently deep anæsthesia for the kind of a case we are now discussing. In fifteen to thirty seconds the patient can be anæsthetized by this method.

I do not believe that this method should be used in routine work. The anæsthetic effect is not as pleasant to the patient; the anæsthesia induced is nearly always more profound than is necessary; the patient is more apt to create a disturbance in the beginning and be nauseated afterwards; and it is certainly more dangerous than the method which I will next describe.

Admission of Air.—The mouth-prop is in position and the patient is ready to be anæsthetized. Fracture a 3 c. c. somnoform capsule in the capsule chamber. Say nothing about the breathing in the beginning. Place the inhaler over the nose and mouth. After two or three inhalations with all anæsthetic excluded, release valve, gradually admitting more and more somnoform, then one or two inhalations with all air excluded. With some patients it is not necessary to

exclude all air. If a deeper anæsthesia is desired, more inhalations can be taken with the air excluded. If the patient breathes normally, do not interrupt her. If she breathes too deeply or not deeply enough, then in a quiet, firm voice command or suggest the degree of respiration you desire. Anæsthesia thus induced is much more agreeable to the patient, there is rarely struggling or excitement, nausea seldom occurs, and supervening headache is almost unknown. Circulatory disturbance is less marked than when all air is excluded, and it is certainly much safer, especially with elderly people with brittle arteries.

Just at this stage we will assume that instead of one tooth this patient has half a dozen teeth to be removed. The patient has had but one or two inhalations, we will say, with all air excluded. Now hold your ear very close to the face piece. You will hear, by the time two or three more inhalations have been taken, a little low purring sound. This is caused by relaxation of the soft palate, and comes with a little deeper anæsthesia than is usually necessary to relax the arm muscles. Let me add here, that, when this gentle snoring sound is heard, I believe the patient is as deeply anæsthetized as is necessary for any surgical operation, and to anæsthetize longer is to over-anæsthetize the patient without getting a more profound anæsthesia.

For extracting cases, when light snoring is heard, remove the inhaler (Stark) or evert the mouth cover with the DeFord inhaler and begin to operate. When other operations are to be performed, other than mouth

operations, at this stage of the anæsthesia, **remove the inhaler or open the valve for in inhalation or two of air, then replace it and proceed as you would with chloroform or ether.** In this way, **I kept a patient under the influence of somnoform for twenty-five minutes.**

For an easy extraction, it is not necessary to push the anæsthetic far enough for snoring.

Let us suppose that our anæmic patient, after taking two or three inhalations of somnoform is getting approximately one-third somnoform and two-thirds air, should, through dread or apprehension, become a trifle nervous and move the hands and feet, I would **shut off nearly or quite all air and anæsthetize the patient quickly.** This seldom happens, but, when it does, I induce a quick anæsthesia.

Our next patient is a **plethoric** one about thirty years of age, medium height, weighing about 150 pounds, for whom it is necessary to extract a lower left second molar. We have said that **this patient is plethoric,** and this is the keynote of this case. We have this time to deal with **a red-faced, full-blooded patient.**

We have already shown that the blood flows a little more rapidly as the result of somnoform administration, and in plethoric people, as a rule, **I admit more air in the beginning than when anæsthetizing anæmic patients.** If all air is excluded from the very start, these patients are **apt to become excited.** The circulation starts up too rapidly and increased circulation causes a feeling of fullness in the head, roaring

and unpleasant noises are heard and we have a condition more like that produced by nitrous oxid. The patient becomes distressed before becoming anæsthetized, and the dream experienced is not a pleasant one, as a rule, if the air is insufficient or excluded in the beginning.

The mouth-prop is adjusted and the patient is ready and the inhaler, the Stark, is in position. For the first three or four inhalations exclude all somnoform, admit air only, then gradually admit more and more somnoform. If the case is not very difficult and the extraction can be made quickly, it may not be necessary to exclude all air, but if the case is difficult, one or more inhalations with all air excluded may be necessary. You have now simply to watch your patients for anæsthetic symptoms and proceed from now on just as with the anæmic patient. These plethoric patients can be anæsthetized just as quickly as anæmic patients, but I always take a little more time with the former and am satisfied that I am well repaid for using a little slower method.

I tested the Stark inhaler for more than a year before mentioning it in a dental journal or using it at a dental meeting. I described it in the Dental Brief for December, 1907, and gave a talk and demonstration, December 4th, '07, before the junior medical class and the senior and junior dental classes of the Colleges of Medicine and Dentistry, State University of Iowa, anæsthetizing a dozen students selected by the professor of materia medica of such temperaments and pathological conditions as he wished anæsthetized for the

benefit of the class. Just a year previously I anæsthetized Prof. Chase and three of his medical students, with the de Trey inhaler, within a period of fifteen minutes, and in ten minutes after anæsthetizing Prof. Chase he was lecturing to another class.

Let us select this time a nervous little black-haired, sallow patient given to hysteria, one that insists she knows she can not take "the stuff" because she will die. She also knows that it will nauseate her, and that she will have an awful dream, etc. These patients become very nervous, usually, before taking the first inhalation, and, if the first inhalation is strong, they go all to pieces.

This patient has the teeth properly held apart, the inhaler is in position and the patient begins to inhale.

This patient is studying the effect very closely and will rebel at the slightest provocation. With the Stark or De Ford inhaler, you can have her breathe for five minutes, if you wish, and the patient will not get so much as an unpleasant odor. All this time you can be suggesting that the anæsthetic is not the least bit disagreeable, that the odor is mild and pleasant, and when you are ready you can admit just a trace. By this time, the patient is calmed, thinks there is nothing disagreeable about it, and, by gradually admitting a little more at a time, it steals so quietly over the mucous membrane into the lungs that the patient is anæsthetized before she knows it, without a struggle. I have accomplished this scores of times, with patients that gave every evidence of a most unsatisfactory anæsthesia. Yesterday I operated for a little red-headed girl of

seven years of age. She was very brave till I placed the mouth-prop in position, then she lost all control of herself and it looked like a defeat. I placed the inhaler over her mouth and she held her breath. I knew she could not hold her breath forever, and **the longer she held it the deeper would be the next inhalation.** The inhaler was over her mouth and a physician and her father held her hands. When she started to exhale, I turned on **about ten per cent. of somnoform, which went into her lungs with that first deep inhalation. The same amount the second time; the third time, I only admitted about half as much somnoform, for she was breathing very deeply.** One more inhalation of about five per cent. of somnoform was all she needed, and I made a successful extraction of a sixth-year molar in a state of acute alveolar abscess too badly broken down to save. **You can control the amount of somnoform desired for a given case absolutely with the Stark or De Ford inhaler.**

I could have held the inhaler over the mouth of this patient till she resumed normal breathing, had I so desired, **without the little girl inhaling a bit of somnoform,** but she was growing more nervous, of course, all the time, and I was so sure of my appliance that I felt no alarm whatever. I could not have made this fine adjustment **with any other appliances with which I am familiar.**

When speaking of nausea, I referred to a young lady whose stomach was so delicate that the odor of meat being broiled or fried was sufficient to nauseate her. Her mother called me to one side and explained

this before I administered the anæsthetic, thinking she might become sick before I had time to begin the operation. I knew this young lady had to be handled very carefully or we would be defeated and fail to make the extraction. I was as careful in this case as with the hysterical patient previously described. I excluded somnoform for a period of a minute or two, allowing only air to pass through the inhaler till I had the patient's confidence, keeping up the suggestion that there was nothing unpleasant about it, then turned on just a trace of somnoform, and continued this for thirty to forty seconds, then just a little more for nearly as long. I knew now that the olfactory nerve was sufficiently anæsthetized not to take cognizance of the odor, and gave her two inhalations without air, and the anæsthesia induced was all I needed. I made a successful operation and no nausea resulted. I may have had patients as sensitive to odors as this one, but, if they were, it was not so thoroughly explained to me, and I did not realize the situation as in this case.

LECTURE XVIII.

Somnoform Administrations—Continued.

I have learned by experience that patients coming from the farm and those leading outdoor lives do not stand deprivation of oxygen to the same degree without discomfort as those who lead a more sedentary life. Clerks in stores, bookkeepers, housewives, and the like, whose work necessitates long hours indoors, can be anæsthetized comfortably with less oxygen than those that spend much time out of doors. I think that this statement will account for some of the cases that have been reported to me by others in which the patient became excited and made a disturbance. **Too much somnoform was administered** in the very beginning and not a sufficient amount of air. The **circulation and** blood pressure being suddenly augmented, the patient becomes violently **stimulated and excited rather than anæsthetized,** and the effect is much the same as that produced by ether in the stimulation stage. Many patients have to be held down during this stage in ether administration, and many more would make disturbances in hospital practice but for the fact that they are strapped to the table in advance, and ether anæsthesias, that to all outward appearances are calm and without a struggle, are so only **because the patient can not move.**

We have this same condition in nitrous oxid, but it occurs much more frequently than in somnoform. We find it present in a much less degree in chloroform than in ether. We have **less of it in somnoform** than with any other anæsthetic with which I am acquainted. In all stages of anæsthesia, from first to last, we may say, nitrous oxid is to ether what somnoform is to chloroform. **In the matter of excitability, we may arrange them in the following order: ether, nitrous oxid, chloroform, ethyl chloride and somnoform.**

In my own practice, I have never had a case in which the disturbance has been of sufficient importance to relate. Perhaps this is so from the fact that I **never attempt to restrain a patient.** There is a stage just before consciousness returns when patients are almost but not quite awake, **in which they are greatly mystified and they do not know where they are or what they are doing or what is being done to them.** This is the time in my practice when I insist on **everybody in the room remaining absolutely quiet. Do not shake the patient, or tell him to lean forward or thrust the cuspidor under his chin** and call to him to spit. Place napkins in the mouth as already explained to absorb the blood and **allow the patient to awake as from natural sleep.** If his dream happens to be an unpleasant one and he should misinterpret your pushing him forward and shaking him for the attack of the villain he sees in his dream, he may feel **called upon to defend himself,** and you have a fight on your hands.

The following case is the most pronounced of its kind that has ever come under my personal observ-

ation: The patient was referred for the extraction of a lower right third molar. As soon as I saw him, it occurred to me that this man would make trouble. In size he was about five feet six inches in height and would weigh probably two hundred pounds. I inquired if he had ever taken an anæsthetic. He informed me that he had about a year previously, at the hospital, and that it took all the doctors and nurses in the institution to hold him. He ventured the opinion that the anæsthetic I proposed using "could not put him to sleep." We made him ready for the anæsthetic, and I motioned to the assistant to stand well back, lest he should strike her suddenly and without warning, with his fist. I had a friend knocked stiff on one occasion by just such a patient, when administering nitrous oxid gas. The patient inhaled as instructed, and I thought him almost ready for the operation; I lifted his hand to test his muscles, and there was where I made my mistake. Two inhalations more would have placed him beyond recognizing any physical disturbance. I disturbed his consciousness, and he said, "Come on, fellows; let's get right after them." He was on his feet in a moment, grabbed the towel from his neck, opened the door into the reception room, put on his hat, went out into the hall, and just as he was entering the reception room of my neighbor, consciousness returned. I walked along with him, telling him to be in no hurry, "Just wait a moment," but not restraining him in the least. We walked back together, he inquired if I removed the tooth or if he made any disturbance, put on his hat, and said: "I will try it

again another day." This man impressed me as being an alcoholic. He would not have tolerated restraint. **It would have been a mistake to have tried to force him to inhale more of the somnoform.**

All other cases in which there has been undue excitement as the result of somnoform administration, in my practice, have occurred **after the induction of anæsthesia and after the patient has been operated upon.**

I recall a case of this kind. At the close of the anæsthesia, the patient grabbed his right side pocket with both hands, holding it tenaciously. I did not try to interfere with him; had I done so, I probably would have been roughly handled. In the course of a few seconds, he realized his actions and laughed heartily. I said, "What kind of a dream did you have?" He replied, "I have $400 in that pocket, and I thought some one was trying to rob me." Had I undertaken to hold this man in the chair, or restrained him, **he would have resisted violently.**

Another case: A large man over six feet tall and well proportioned, at the conclusion of an extraction, said, "Let me out of here." I stepped aside and let him leave the chair. He picked up his hat and walked to the door leading from the private room to the hall. Finding the door locked, he turned and just then regained consciousness, and said, "What am I doing here? Oh, yes; I was having a tooth out. Did you get it?" This man was a pronounced alcoholic. His physician accompanied him to the office, fearing a disturbance, which we would have undoubtedly had **if an attempt had been made to restrain him.**

The following case was reported to me, October 15, 1907, by Dr. Z. T. Roberts, of Rocky Ford, Colo., with permission to use it:

"A farmer, about forty years of age, presented for seven extractions. He took somnoform nicely, and I took out all the teeth. He slept on for probably a minute and a half, when he suddenly shouted "Whoa!" at the top of his voice several times, and tried to get out of the chair. I pulled him back into the chair, and held him, whereupon he began to curse me and struggled to get out. Finally he broke loose, and, raving like a madman, faced me. At this time his reason returned, probably through recognizing me, and he quieted at once. This, I suppose, was merely a freak of anæsthesia, and not uncommon with any anæsthetic; however, it is the only case of the kind I have ever had, and I have been giving it about two years. I have given it, probably, about five hundred times."

This man was driving his horses and evidently **did not wish to be disturbed,** and, had the doctor not **tried to restrain him,** he probably would have **awakened in a pleasant frame of mind.**

This Rocky Ford case reminds me of the delightful time I had in June, 1907, at Colorado Springs, where I attended a meeting of the Colorado State Dental Society. During my talk before the society, I had mentioned that **somnoform is non-irritating to the mucous membrane or air-passages,** being, for that reason, **a most excellent anæsthetic in all bronchial or pulmonary conditions.** At the close of my remarks, a dentist came to me and told me that he was a great

sufferer from asthma. He said that many nights, not being able to recline, he was compelled to sit in a chair all night. He was compelled to stay in a high altitude, then being a resident of Victor, Colo., which has an altitude of more than 10,000 feet. He had listened with great interest to what I had been saying, and requested me to anæsthetize him privately, lest through nervousness or coughing he would cause me to make a failure of my demonstration. I asked him if this was his only reason for desiring a private anæsthetization, and he assured me that it was. I told him not to hesitate for a moment; that he would have the most comfortable and refreshing sleep that he had experienced in years. I placed him on a couch and in about forty-five seconds he was sleeping beautifully. I am sure those present will never forget his many expressions of delight. He stated time and again that he had not experienced such a sense of comfort since his boyhood days.

Dr. B——, another dentist, informed me that he had remained in that high altitude until he had become a nervous wreck. He expressed a desire to be anæsthetized, doubting that one in his nervous condition could be successfully anæsthetized with somnoform. I assured him that he could be as comfortably anæsthetized as the gentleman with the asthma. The prediction proved to be true.

Some months since, I met a friend on the street—a physician—and in the course of conversation he told me that his wife had been suffering with her teeth, and that it was necessary to have four of them extracted, but on account of her impaired physical condition the

operation had been delayed from time to time. This lady is one of the most delicate women I have ever known. About a year previously, while undergoing an appendectomy, she experienced an anæsthetic collapse and for two hours remained in a critical condition. With such a history, her husband was apprehensive as to the outcome of an anæsthesia induced for the removal of these teeth, yet agreed with me that it would be equally hazardous to extract the teeth without employing an anæsthetic. I explained to him the physiological action of somnoform, and we decided to operate on the following morning. The patient is a nervy little woman, and arrived at the appointed hour, cheerful and buoyant in spirits, and I knew that, in such a frame of mind, she could be successfully anæsthetized. The husband had worried all night, and was alarmed lest an accident might occur. I suggested that, at a signal from me, he should place his finger on the radial artery, and if he discovered the slightest indication of approaching danger to nod his head, and I would discontinue the anæsthetic. I did not wish the patient to feel that we were in the least apprehensive about her condition, and for that reason did not signal the doctor to take her pulse until she had inhaled sufficient somnoform to dull her sensibilities. I lifted my eyes every second or two, from the patient to her husband, but he gave no signal. I lifted her hand; it dropped, showing muscular relaxation. I removed the teeth, the patient slept quietly for about thirty seconds, a smile lit up her countenance, and developed into an odd little laugh, peculiar to her, and in five minutes

she was out of the office, on her way home. The amount of somnoform used in this case was not over one cubic centimeter with abundant admixture of air. **It is a very easy matter to over-anæsthetize a patient,** and that was what happened in the case of the patient under consideration on a previous occasion. I have had a number of these cases, in which the family physician refused to administer an anæsthetic on account of an impaired physical condition, that have taken somnoform as successfully as the wife of my friend, the physician.

There is a **condition of analgesia** following somnoform anæsthesia that is valuable to the dental surgeon. After the patient is perfectly conscious and has freed the mouth from blood, there is a period of several seconds in which considerable can be done. Sometimes, in rapid extracting, where a number of teeth and roots are to be removed, the blood so interferes with vision that some of the roots are overlooked, others are loosened but remain in their sockets, and sometimes pieces of process should be removed. There are some patients who think they are being hurt if they know something is being done. This analgesic stage is of no practical value to such patients. But there are other patients who will permit you to operate if they do not feel pain. With this class you can remove such roots as I have mentioned and **they will feel no pain whatever.**

Do not misunderstand me, please. I believe in operating, primarily, while the patient is unconscious and to cease in time so that no pain shall be experi-

enced. Be sure and do that. If there is any little thing to be done during this analgesic stage, it **should be done with the full consent and knowledge of the patient, with the understanding that you will desist if he finds he is being hurt.**

I, with others, have recognized this analgesic stage, but I did not appreciate the extent to which it might be used until I was called on one occasion to administer somnoform to an elderly lady for the amputation of a finger. I had used a 3 c. c. capsule of somnoform in the de Trey inhaler, and noticed that my patient was returning to consciousness and I asked the surgeon if I should fracture another tube. He replied that it would not be necessary as he was almost through, and only had two more stitches to take. Just then the patient opened her eyes and remarked, "I am alive, ain't I, doctor, thank God." I assured her that she was certainly alive. Then she turned to the surgeon and said, "Whose finger is that you are working on?" He replied, "Yours." "Oh, no," she said, "that's not my finger," and she pulled back her arm, and said, "Why, yes, it is; ain't that funny! You are not hurting me one bit."

It is well that we have this analgesic stage in dental operations for the following reason: in cases of acute pericementitis and alveolar abscess and all those cases in which considerable force is exerted, the **pain does not discontinue the moment the tooth or root is extracted, and the after-pain is concealed for a while, or until it subsides in a large measure, or completely.** With nitrous oxid, we do not have this period of anal-

gesia, and patients who have been anæsthetized frequently insist that they have been severely hurt, and felt as much pain as though they had not taken the gas. I believe very many times **it is this post-operative pain that is felt under nitrous oxid, and not the actual pain of operating.**

Yesterday a dentist brought a patient to me to have extracted a lower left third molar tooth. This patient also had an upper right second molar, containing a dead pulp, that was so sore that she could not stand the pressure of instruments to open into the pulp chamber. The dentist requested me to open the pulp chamber under somnoform after removing the tooth. I explained to the patient this stage of analgesia, and I promised her that she would not be hurt, although she would probably know when I drilled into the tooth. I anæsthetized the patient with somnoform, extracted the third molar, shifted the mouth-prop, opened into the pulp chamber without pain or annoyance to the patient.

When the nervous system has become disordered by the use of tobacco, chloral, alcoholic indulgence, morphine or other narcotics, **patients usually exhibit abnormal symptoms during or after anæsthetization.** These conditions, no doubt, explain abnormalities and account for the action of some individuals that otherwise might remain a mystery. Morphine is often injected shortly before administering an anæsthetic to **deepen** and **prolong the anæsthesia,** but those addicted to the use of morphine are sometimes rendered almost immune to an anæsthetic. Dr. R. J. Carter furnished

Hewitt, of London, an account of a case in which the patient, a morphiomaniac, was an hour and three-quarters being anæsthetized, and eight ounces of chloroform were expended. I mention this as a matter of interest, as it may serve as an explanation, should you in your anæsthetic practice, on some occasion, **fail to produce narcosis.**

Alcoholics are always dreaded, no matter what anæsthetic agent is employed. I have experienced very little difficulty, however, with alcoholics when administering somnoform. I have had a number of narrow escapes with nitrous oxid and became suspicious of any person that smelled of liquor. My rule with nitrous oxid has been to postpone the operation if I detected the odor of liquor on the breath. I also adopted this rule with somnoform, and adhered to it strictly for two years. One day I was summoned by 'phone to administer somnoform for a finger amputation. When I arrived, I found a man who had caught his finger in a sausage machine and crushed it so badly as to necessitate amputation. This patient had taken several drinks of whisky and was partially intoxicated. I did not know how successful I might be with somnoform, but there was nothing else to do. I decided that I would make as quick an anæsthesia as possible, and give him no time in which to become excited. **I had him snoring in thirty seconds and he never so much as disturbed a muscle of his body.** Thus deeply anæsthetized, I admitted two inhalations of pure air, and after that I permitted him to take one inhalation from the inhaler and two inhalations of air

throughout anæsthesia. There was no excitement, whatever, either during or after the anæsthesia. This experience excited my curiosity, and I determined that in the future I would not refuse to anæsthetize a patient because of the fact he had taken a drink. Since then I have refused no patient on that account, and I have had no occasion to regret so doing. It has been my privilege to anæsthetize many pronounced alcoholics. I recall now the case of one of the most pronounced alcoholics in this State. This man was referred for the extraction of an upper third molar on the right side. I admitted an abundance of air along with the somnoform in the beginning of the administration, and as it commenced to take effect, he said, "For Christ's sake, don't begin yet," and commenced to lean forward. I held the inhaler over his face, but made no attempt to restrain him. By the time he was ready for the operation, his head was far enough forward to rest his chin on his knees. I got down on one knee and did the extracting. All this time he was repeating the sentence quoted above, and said it ten or twelve times after the tooth had been removed. In about a minute he sat upright in the chair, expressed himself as having experienced no pain, and was surprised to know that the tooth was out. It is said to be difficult and sometimes impossible to secure total muscular relaxation in alcoholic patients, and the above case is a good example of this condition. His muscles were contracted from the very beginning and did not relax at any stage of the anæsthesia. He was neither boisterous nor noisy, and made no physical demonstration whatever.

About a month ago, two physicians brought to my office a third physician to be anæsthetized. This patient, a month previously, had been brutally attacked by some ruffians and in the fracas had the lower maxilla fractured on both sides in the mental foramen region. Union was just nicely established and the bandages and splints removed and it was found that the second molar on the right side had moved forward in such a way as to prevent the mouth closing and we all agreed that the tooth should be extracted. This patient had been under **the influence of liquor and morphine for a month.** He told me afterwards that he **took three big drinks just before coming to the office.** When I commenced to anæsthetize him one of the physicians without being told closed in on his knees and braced himself in front of the patient. The other physician stood on the left side and grasped the wrist of each hand. I had never had a patient held like this before, but there was no time to argue the case, so I said nothing. The tooth extracted, the patient was a little excited and warned them not to attempt that again as he had his gun with him this time and would blow their brains out if they did. In about a minute he was all over his anæsthetic. He told me that in his dream the same crowd was after him. I do not know, of course, what kind of a time we might have had with this man alone. The physicians told me afterwards that they knew that he was armed and that was why they came over with him. I was very glad that they came, because I went through a nitrous oxid experience on a former occasion when an alcoholic had

a revolver and it took a policeman and four men to take it from him.

After that experience, as long as I remained in the South, I always, for a man, felt his hip pocket before administering gas. Nearly every Southern man in those days carried a revolver.

LECTURE XIX.

Somnoform Analgesia.

In what class of cases do I advocate somnoform analgesia? In all painful conditions the dentist is called upon to treat in which the dread of the operation or the pain to be inflicted is of such a nature or character as to interfere with or mitigate against the performance on the part of the dental surgeon of the very best operation for the case under consideration, with the exception, possibly, of two classes of cases, viz.: the removal of one or more teeth that give evidence that great suffering would result, and the removal of live teeth pulps.

Somnoform can be used to good advantage in all painful conditions which the dentist is called upon to treat.

There are times in the preparation of a sensitive tooth for filling when a little more cutting must be done, yet the patient has reached the limit of endurance. Can you recall such a case? A few inhalations of somnoform will not only permit of painless cutting, but the patient will be rested and refreshed for the remainder of the operation.

Sometimes in preparing a tooth for a crown, just at the juncture of the enamel and dentine, the sen-

sibility is so great that further cutting seems impossible, yet more space must be gained. Three or four inhalations of somnoform render the patient insensible to pain.

A patient presents with a case of acute dental pericementitis arising from a dead pulp. The tooth is so sore that the pressure of the tongue against it causes excruciating pain. **The pulp chamber should be entered for drainage.** In years gone by I have spent an hour or more in entering the pulp chamber of such a tooth. **By the use of a few inhalations of somnoform, vent or drainage can be secured in a minute, painlessly.**

A child has been awake all night crying because of a case of acute pulpitis. She comes to the office next morning all worn out from loss of sleep and hours of suffering, added to which is the dread of being hurt. Softened dentine must be removed and the pulp exposed, and the dental surgeon dreads doing this almost as much as the patient dreads having it done. **Just a little somnoform inhaled will enable the dentist to make an exposure and seal in an emolient treatment before the little one opens her eyes or knows that the tooth has been touched.**

Exposing pulps for arsenical application or removing a pulp after an arsenical application has remained the requisite time, for those patients who suffer mentally from anticipation of being hurt; evacuating pus in acute alveolar abscess, lancing or removing a portion of the gingival tissue in unerupted, impacted, or belated third molars; removing deep cerumal deposits

from the roots of the teeth and cauterizing deep pus pockets; opening into the antrum; amputating roots of teeth in cases of chronic alveolar abscess; operating for dentigerous cyst, alveolar and maxillary necrosis; simple extractions of teeth, and other operations that dental surgeons are called upon to perform. Be humane, look to the best interests of your patients and yourself, and with somnoform or some other anæsthetic, do all these operations painlessly. The time is coming when dental surgeons will look back on the present cruel and barbarous methods of operating with pity and sorrow in their hearts just as the general surgeon recalls the thousands of failures he made in the years that have passed when anæsthetics were not available. The average lifetime of fillings, inlays, crowns and bridges will be doubled and trebled when we are able to make the kind of preparation we well know should be made, but neglect to make, fall short of the ideal, because of the objections urged upon the part of the patient, because of the pain inflicted.

In May, 1908, I gave several talks and clinics before the Nebraska State Dental Society at Omaha. As I passed out of the lecture room to the clinic room, Dr. Frank Hetrick of Ottawa, Kan., called to me, "Come on, DeFord, I have been waiting for you. Get your somnoform."

Dr. Hetrick's clinic was to make two Ascher Artificial Enamel fillings in the approximal surfaces of two upper central incisors. He remarked, "I have gone just as far as I can with this case. The teeth have

become so sensitive that I can not even touch them with an excavator." I said to the patient, "Are you willing to take a few whiffs of somnoform?" He assured me that he certainly was, but that he knew it would not be successful in his case. Then he told me this: "I am a dentist and I reside in Lincoln. No one has ever yet been able to make a correct cavity preparation in any of my teeth. Last year at our State Meeting, held at Lincoln, I sat four hours with rubber dam adjusted. Cocaine, eucaine, pressure anæsthesia all availed nothing. Worn out completely with the suffering incident to the operation, I could endure no more, and cement was placed in this partly prepared cavity, as had been done on former occasions with other teeth." "But," I said to him, "you don't mind trying the somnoform, do you?" He replied, "I would try anything." I explained that if he experienced any further pain in this operation that he had only himself to blame. That the moment he felt the slightest pain or thought that he was going to be hurt to simply raise his hand so we could see it, and that Dr. Hetrick would cease immediately. I administered about three inhalations of somnoform and signalled to Dr. Hetrick to proceed. The Doctor had almost completed the preparation he wished in one tooth when the patient's hand started to ascend. Some one in the audience called out, "Is he hurting you"? The patient replied, "Not a bit and I do not want to be hurt." I administered about three more inhalations of somnoform, and this time both cavity preparations were completed without the least pain. This gentleman was

at no time unconscious. He looked up to me and said, "Doctor, I would go to Europe, if necessary, before I would ever have another cavity prepared in any other way." The entire time from the first inhalation till the conversation just related took place was less than three minutes, some one in the audience announced.

About a month since one of our students, as the result of a dead pulp in an upper later incisor, presented with a case of acute septic apical pericementitis. The slightest touch of lip, tongue or food caused excruciating pain. Three inhalations of somnoform proved ample to induce a state of analgesia sufficient to enter the pulp chamber with a bur through the lingual pit. This young man was very timid, inhaled the somnoform with misgivings as to the result, but after the very first inhalation the stimulating effect was produced, fear was dispelled, and he shook with laughter during the drilling, and did not experience the slightest pain. The entire procedure required less than a minute. At this juncture a dentist entered the room and we explained what we had been doing. He expressed regret at not having been able to witness the operation. I had him examine the case and test the condition present by gently percussing the tooth. Then I said to the young gentleman: "Will you take the same amount of somnoform again?" He consented. In fifteen seconds, with three inhalations, he was in this same condition of joyous analgesia, and tapping the tooth so that the sound could be heard throughout the entire room elicited no evidence on his part that he experienced the slightest discomfort.

Soon after opening our clinic at the beginning of the present school year, a young man presented for a large amount of dental work, a student at the Agricultural College some forty miles distant. This case would have taxed the ingenuity and skill of the most successful of dental practitioners. Among other carious cavities there were five along the gingival margins of the lower anterior teeth.

These were all so deep as to demand pulp removal. They were so sensitive as to render instrumentation impossible. They were so deep or extended down so far gingivally that rubber dam adjustment was not to be considered. Saliva was so excessive the cavities could not be kept dry a sufficient length of time by means of cotton rolls and napkins. Patient could come only on Saturdays.

This is one of the cases in which I would prefer a condition of anæsthesia for operation rather than analgesia. A few inhalations of somnoform were administered; in about forty-five seconds the patient was anæsthetized. With rapidly rotated, good-sized bur, the five pulp chambers were thoroughly opened, the patient showed not the slightest evidence of pain and denied feeling any upon awaking, and the entire time consumed was less, I should say, than two minutes from the first inhalation of somnoform. Each pulp being completely exposed, no more drilling was necessary, and the operation was completed by the use of pressure anæsthesia by the student in charge of the case.

Hundreds of similar cases could be cited. They

are of every day occurrence. Indeed, several times every day such cases present in the practice of every dental surgeon, yet how few men avail themselves of such an easy method of handling these cases.

In giving a detailed description of how to proceed in these cases it will be necessary, of course, to repeat in substance, if not in language, some things that have already been said in explaining the technic of analgesia when nitrous oxid and oxygen was the agent under consideration.

The De Ford Somnoform Inhaler.

The De Ford Somnoform Inhaler has been constructed to meet this class of cases. By means of this inhaler, continuous analgesia can be maintained without removing the inhaler from the face as must be done with all other somnoform inhalers.

In order to simplify matters let us assume that an occlusal cavity in a lower first molar has become so sensitive that the patient seems physically unable to have the operation completed, yet the cavity is not properly shaped for the gold inlay you have contracted to make.

Adjust the appliance to the nose, making it tight by means of the retaining strap. Prop the mouth open as wide as patient will tolerate. Then adjust the mouth cover, and when it assumes the proper position, tighten the set screw. See that the exhalation valve is closed in the nasal inhaler. See that the valve is closed that holds back the somnoform and prevents it from escaping till it is needed. With the valve in this position,

the patient inhales air only and no somnoform. Steady the mouth cover with the hand and turn on just a trace of somnoform, then a little more. Let the patient breathe normally. Say nothing about the respiration. Do not attempt to tell the patient how to breathe unless the breathing does not suit you. If the patient breathes too deeply, say in a quiet, firm voice, "It is not necessary to breathe so deeply." If breathing is too shallow, "Breathe a little deeper, please." If you do not get patients confused by trying to tell them how to breathe in the beginning, you will seldom have to say anything about breathing.

Have the patient understand that if pain is being felt, the lifted hand will indicate the same, and administer a little more anæsthetic. After two or three inhalations say to the patient, "Do you feel drowsy; are you getting sleepy?" The nature of the reply will indicate to you their condition. If they answer up quickly, and you discover the natural tone of voice, it is too soon to begin to operate. If they drawl out "y-e-s, yes," in a sleepy, uninteresting manner, you can usually begin to operate.

Elevate the mouth cover; shut of the somnoform. Admit a little more somnoform when it seems necessary. Just as consciousness is being lost begin to operate, gently testing the sensitivity of the tooth.

It will not do at this stage to hold the bur hard against the dentine and run the engine at highest speed. If easy cutting can be accomplished without a protest on the part of the patient, keep on cutting, saying all the time, "Am I hurting you?" "Do you

feel pain?" etc. If the hand is raised or the facial expression indicates that pain is being felt, a little more somnoform is indicated. When patients refuse to answer they are usually deeper than necessary. In the state just between sleeping and waking you can usually cut the most sensitive dentine without the slightest pain.

You have only by experience to learn to maintain this analgesic stage.

If you are a tyro in anæsthetics, have had no practical experience, read carefully several times the lecture on "Elements of Success" before attempting to administer somnoform for other operations than extracting.

Indeed, **in order to succeed in this line of practice, one should administer somnoform for extraction cases till he is familiar with the physiological action of this anæsthetic, till he has gained confidence in himself and is master of the situation.**

This technic is applicable to every case in which the rubber dam is not adjusted.

In all cases in which the rubber dam is in position, the mouth cover is unnecessary. The mouth cover is easily removed by sliding it to the left. The rubber dam now excludes the air from the mouth and we proceed exactly as before. As no somnoform escapes from the mouth it is not necessary to admit quite as much to the nasal inhaler. The amount varies with individual cases.

In the case of lady patients, when you make your appointment for a given operation, **if you anticipate us-**

ing somnoform or think perhaps it may be necessary in this case to do properly what you wish, **request them to leave off the corset** when dressing for the office, as this saves complications after the patient arrives. You **always get a more comfortable, a safer and a more successful anæsthesia with the corset off, and do not run the same risk of nausea.** It is better also, when convenient, to **make appointments two or three hours after a meal, or have the patient eat lightly or not at all if the appointment comes just after the breakfast or lunch hour.**

If a patient presents with a severe case of acute alveolar abscess, the result of a dead pulp, with a tooth so sore that it seems out of the question to undergo the pain of entering the pulp chamber, insert mouth-prop and without adjusting the dam, **anæsthetize the patient just as you would for the extraction of teeth.** With a good engine and a sharp bur enter pulp chamber.

If the operation is the **removal of a live pulp,** with the dam adjusted and a prop inserted **administer somnoform as you would for an extraction case.**

If you wish to thoroughly cauterize pus pockets or curette them, have all instruments and the medicinal agent to be used in readiness, adjust the mouth-prop and induce somnoform analgesia.

Take time to bathe the tissues with a cocaine solution or cocaine ointment to prevent or lessen after-pain. In any case in which the analgesia state is not sufficient for comfortable operating, only two or three more inhalations are necessary to induce surgical anæsthesia.

One such thorough treatment under an anæsthetic does more good, frequently, than weeks of treatment with milder agents.

In preparing sensitive teeth for crowns or abutments, the amount of cutting necessary will suggest the method to be employed. With some patients the grinding is far **more objectionable and more wearing and exhausting than severe pain** for the same length of time. If the grinding is to cover several minutes, I would adopt the same method as described for cavity preparation, without adjusting the rubber dam. If just a little cutting was necessary, when the sensitiveness became too severe I would suggest a deeper anæsthesia and complete the grinding without prolonging the anæsthesia.

It is not necessary for me to dwell upon the advantages of operating under anæsthesia. It is apparent to every one, and a safe method by which this could be accomplished **has long been looked for and prayed for, not only by the dental surgeon, but by the patient.** Only an infinitesimal number remain away from the dentist on account of the fee. The masses postpone dental operations and allow their teeth to fall to pieces in their mouths **because of the torture** that must be endured in having them operated upon. Could some man invent a scheme by which he could restore all diseased teeth to health and the patient had but to have him glance into his mouth, when instantaneously, inlays, fillings, crowns and bridges would fly into position, **the check book would be produced and any price named would be cheerfully paid.**

LECTURE XX.

Chloroform Analgesia.

Dr. Austin C. Hewett, of Chicago, was the first man to advocate the performance of surgical operations in a state of chloroform analgesia. He was one of the first men, if not the first, in the United States to use chloroform. As soon as the news reached America that Sir James Y. Simpson had used chloroform successfully, Dr. Hewett imported a small quantity from London at a fabulous price and commenced to experiment. At the time the chloroform arrived, Dr. Hewett was suffering with an abscessed lower molar. He took a few inhalations of chloroform and proceeded to evacuate the pus. He pressed a lance into his gum without any sensation whatever. Upon removing the lance he was amazed, for the stain on the blade indicated that it had passed a quarter of an inch into the tissue. He then took a forceps, and, adjusting it to his tooth, made careful lateral movements without pain. Thus encouraged, he extracted his own tooth without the least discomfort. Dr. Hewett was at this time a medical student and for years after graduating had a large medical and surgical practice in Southeastern Michigan. For a period of more than twenty years he performed all kinds of surgical operations in a stage of analgesia,

notwithstanding all the authorities in this country and abroad maintained that this was a most dangerous procedure. During all these years, had a death occurred while operating in this stage of analgesia, he probably could not have found a medical man in all the world to go on the witness stand and testify in his favor. After an extensive medical and surgical practice covering a period of twenty-five years, realizing the great necessity for the use of anæsthetics in dentistry, he abandoned medicine and opened a dental office in the City of Chicago, quickly establishing a large and lucrative practice by the use of chloroform for all operations upon the teeth. Indeed, he refused to operate in painful conditions unless the patient inhaled chloroform.

In May, 1893, and again in May, 1895, Dr. Hewett read papers before the Iowa State Dental Society on chloroform analgesia, which so impressed the society that a committee was appointed to visit Dr. Hewett at his office in Chicago and make a report of what he was doing. As the writer was the chairman of that committee and wrote the report which was printed in the proceedings of the Iowa State Dental Society, for May, 1896, he takes the liberty of reproducing portions of that report in these lectures.

"We, the undersigned, a committee appointed at the last annual meeting of the Iowa State Dental Society to visit Chicago and investigate the Hewett method of anæsthesia, beg leave to submit the following report: On the morning of July 17th, 1895, at 9 A. M., per agreement, the committee met at the Palmer House and proceeded to the office of Dr. A. C. Hewett, No.

491 West Adams Street. We found Dr. Hewett, his assistants and a number of patients awaiting our arrival. The committee had placed in Dr. Hewett's hands a month or more in advance a list of operations they wished to have him perform, covering the entire field of operative dentistry. When we arrived, Dr. Hewett extended to the members of the committee the privilege of bringing to his office any one they wished, designating the operation to be performed. Further, the members of the committee were not only invited, but urged to perform the operations themselves, he administering the chloroform and designating when to operate.

"Case I. Operation—Preparation of Cavity of Decay.

"Bessie W—, age eleven; frail, delicate child, poorly nourished; anæmic. Cavity of decay in lower left first molar grinding surface. Engine was used till the tooth became very sensitive, then chloroform was administered—twenty inhalations. Time of preparation of cavity, two minutes. Child reported 'no pain' after inhaling the chloroform. Said she 'would not dread to come again.' Amalgam was used for the filling.

"Case II. Operation—Extraction of Roots of Tooth.

"Miss McI—, age about thirty; roots of lower right first molar beneath the gum. Used modeling compound for an impression; impression enlarged a little. In this was placed, along the sides, cotton, saturated with 'Hewett's compound cocaine pigment.' The parts were thoroughly dried, the four per cent. cocaine solution applied to remove mucus and foreign substances;

the modeling compound slipped back in position and the patient instructed to bring the teeth together. Now the patient was ready for the chloroform and took sixteen inhalations; roots were removed. On being questioned, patient said, 'No hurt, nothing, not the slightest pain, but knew when I opened my mouth and when the instrument was applied.' No unpleasant symptoms.

"Case III. Operation—Amputation of Pulp.

"Miss McI—, age about twenty-seven; dried gums and used compound cocaine pigment prior to adjusting the rubber dam.

"Tooth, upper right bicuspid; surface involved, mesial. Broke down the enamel walls with a chisel before administering chloroform. Patient never had taken chloroform before. Eighteen inhalations. She seemed to be suffering, judging from the facial expression. The coronal portion of the pulp was entirely removed by a fast-rotating bur. Pulp bled profusely; dressed with eucalyptol. After the hemorrhage ceased, a pellet of tin foil was burnished over the remaining portions of the pulp and cavity filled with cement. Operation to be completed at another sitting. Patient reported 'no pain,' but knew what was going on. When asked if she had been instructed not to eat before coming, replied that nothing had been said to her about that; she had eaten breakfast as usual and a hearty lunch. On being further questioned, said 'I would not dread to have the same operation performed on another tooth.'

"Case IV. Operation—Extraction of Roots of Tooth.

"Miss ——, age thirty-five; roots of lower right second molar beneath the gum. Took impression with modeling compound; dried the parts; removed mucus with four per cent. cocaine solution, then replaced the impression containing cotton saturated with compound cocaine pigment, allowing to remain about a minute before and during inhalation of chloroform; thirty-two inhalations. This was a difficult case, the tissues surrounding being highly inflamed and sensitive. Patient reported no pain. Said she had been trying for two years to get the courage to have the roots removed. Never took chloroform before; no nausea, no unpleasant after symptoms, although she had eaten a hearty lunch just before leaving home.

"Case V. Operation—Shaping Tooth for Gold Crown.

"Mrs. W—, age forty-five; lower right second molar; patient a delicate, frail woman. Applied four per cent. cocaine solution to the gum; ground tooth with corundum-wheels till it became sensitive at all points; indeed, very painful. Chloroform was now administered, six inhalations, and grinding continued until patient indicated it was painful, then eight more inhalations of chloroform, and the operation was completed. Tooth was cauterized with weak solution of silver nitrate, and patient dismissed. Time, about five minutes; tooth having small neck and large crown, bell-shaped, considerable cutting was necessary.

"Case VII. Operation—Amputation of Pulp.

"Mr. M—, age thirty-seven. Upper left cuspid, mesial surface. Four per cent. solution of cocaine applied to the gum, rubber dam adjusted and chloroform administered. Pulp chamber entered with rapidly rotated bur. Pulp bled profusely, eucalyptol used as a dressing; tin foil burnished over the remaining pulp, and cavity filled with cement. Patient felt some pain; no nausea, headache or uncomfortable symptoms from the chloroform.

"Case VIII. Operation—Extraction and Replantation.

"Miss——, age twenty-five. Superior right central incisor elongated a quarter of an inch beyond the cutting edge on the adjoining tooth. Impression taken and cocaine applied as in former extractions, and held in place while taking twenty-six inhalations of chloroform. Pulse, before taking the anæsthetic, 120 per minute, at time of extraction, 100. Tooth extracted and bathed in eucalyptol, apical foramen enlarged and pulp removed; pulp chamber and canals filled with chloro-percha. Socket deepened with bur, tooth placed in position and driven up with a hammer, bringing the cutting edge on a line with the left central. A splint was constructed and applied and the patient dismissed till the following day. Time consumed from beginning to close of the operation, twelve minues; no pain.

"Case IX. Operation—Preparing Tooth for Filling.

"Prof. C—, age thirty-six. Upper right first molar,

mesial and occlusal surfaces. Applied compound cocaine pigment to the gum and adjusted rubber dam; used engine till cutting was very painful; then administered chloroform, twelve inhalations. The Professor expressed himself pleased with the results, as the cavity was ready for filling in about three minutes."

"Dr. Hewett's Attitude in Relation to Chloroform.

"'To more fully define my attitude in relation to chloroform as an obtundent,' says Dr. Hewett, 'I wish to say that in all the range of operative dentistry, and in the demands of oral surgery, there are but four to six operations demanding or justifying its exhibtion to complete anæsthesia. The obtundent influence is ample. **Under no circumstance is a dentist justified in fully anæsthetizing a patient for extraction of teeth** or for minor operations or oral surgery. During a somewhat lengthened practice never an accident or an approach to an accident has occurred.'

"As a result of careful study and extensive use, Dr. Hewett does not hesitate to commend its general use as an **obtundent.** (Please observe the emphasis on that word.) When given as Dr. Hewett describes, 'it is safe for the young and aged, the robust and feeble, the sick and the healthy, the nervous and the stolid. Thus used as an alleviator of pain, chloroform has no known rival. A substance in the hands of the unskilled and reckless, as dangerous to human life as prusic acid or dynamite, but used properly, legitimately, as safe as the odor from the heart of a rose.' (Hewett.)

"**How Administered.**—'Having tested numberless devices, from a sponge to an elaborate machine, I (Dr. Hewett) have chosen a means so simple as to be almost ridiculous. A wide-mouthed, half-ounce to ounce bottle, an ordinary morphine bottle, is as good as any. Any glass bottle two and one-half inches high, an inch and one-half in diameter, with mouth three-quarters of an inch across, will do. Of course, it should be clean. If the chloroform is to be kept in the bottle after administration, the cork or stopper should seal hermetically, and the bottle wrapped in dark paper and kept in a dark place. The chloroform should be pure, never of a doubtful manufacture. No preparation of the patient is necessary, except that an empty stomach is to be preferred. Or if the drug is to be given soon after a meal, the food should be light in quality and quantity; otherwise, if the obtundent effect is pushed to or near the anæsthetic line, slight nausea may supervene—the only ill effect Dr. Hewett has observed, even with the stomach overloaded. 'Place not more than two or three drams of chloroform in the bottle. With the bottle open, place it near one nostril of the patient nearly on a level with the nose, remembering that the vapor of chloroform is heavier than the atmosphere, and the narcotized air tends to fall. Compress the opposite nostril, and direct the patient to take long, steady inhalations across the bottle's mouth. Do not tolerate spasmodic or jerky breathing. When an inhalation has occurred, remove the bottle so that nothing exhaled shall enter to contaminate the chloroform. At first the bottle

should be distant enough for only the faintest odor to be detected; at no time near enough to irritate the fibrillæ of nerves spread out upon the Schneiderian membrane, the throat and lungs. Do not give the peripheral nerves a shock. The medulla oblongata lies closely contiguous, and will respond to the irritation all too readily. Remember that the nerves of the mouth, nose, throat and lungs in their ultimate distribution, if on a plane, cover a space of twelve to fourteen hundred feet, all readily accessible to the narcotic-laden air. Nerve impulse largely controls the sanguineous circulation. The blood absorbs the drug, and its globules roll over each other to the heart, to be sent out to the brain, viscera and ganglia again.

"'Avoid shock, the first more common cause of death from chloroform. Allow the chloroform to steal over the peripheral sentinels so gradually, so warily, that it shall not fire an alarm to the trigemina and medulla. As the long, regular breathing goes on, the bottle can be placed nearer the nose till stronger vapor is taken. Presently the eyelids will begin to droop or "wink" lazily, the muscles somewhat relax, and an obtundure—to coin a word—creeps over the nerves.'

"In such a state Dr. Hewett extracted his own tooth, and in such a state operates for his patients. In this condition the drill or bur can be carried to the live pulp and the pulp amputated, and afterwards the patient will say, 'I knew what you were doing, but it did not hurt.' In the case of children, they will sometimes moan and cry out, but after restoration

express no resentment, and all dread of subsequent operations is dispelled. From what we saw and learned in Dr. Hewett's office, the committee makes the following observations:

"That Dr. Austin C. Hewett, in his method of administering chloroform for surgical operations, is at variance with all known authorities in that

"First. His patients are not placed in the recumbent position.

"Second. That he operates in the first stage when an obtundent effect is produced rather than the stage of complete anæsthesia, and denies that shock is ever produced, when chloroform is administered as he directs, from operating in the 'obtundure' stage.

"Third. That in thirty years' experience in his method of administering chloroform for dental and minor surgical operations no dangerous symptoms have ever been observed.

"Fourth. That pain can be reduced to a minimum, or be entirely overcome, and operations on the teeth, other than extracting, can be performed in a third to a quarter of the time ordinarily required.

"Fifth. That an operator can do from a third to half more work at the chair each day by using chloroform, and save fifty per cent. of nerve force that ordinarily is expended in quieting and encouraging patients.

"Further, that we were gratified at the results produced.

"Daily we are amputating nerves, disemboweling them, causing groans and entreaties, tears, shock often

to syncope, sometimes collapse." We believe that it is as incumbent on dentists to perform operations painlessly as physicians, and that Dr. A. C. Hewett has made this possible, that the average painstaking, intelligent practitioner, with proper instruction, can learn to use this method advantageously.

"'It was from the discovery of Sir Humphry Davy that the inhalations of nitrous oxid gas would relieve the pain of cutting a wisdom-tooth that the first notion of inducing anæsthesia by inhaled vapors took its rise. It was for the extraction of a tooth that Horace Wells gave to the notion its first practical embodiment. For a similar operation, Morton succeeded in inducing insensibility by means of ether. The first operation performed under the influence of ether was the extraction of a tooth.' Who has a better right than the dental surgeon to use anæsthetics?

"We believe that a chair of anæsthesia should be established in every dental school, in order that anæsthesia, both local and general, may be scientifically studied and taught. That the resolution on the records of this society opposing the use of chloroform in dental practice should be declared null and void. That the dental profession at large, as well as this society, owes a debt of gratitude and a vote of thanks to Dr. A. C. Hewett for making public his discovery. That the Iowa State Dental Society is indebted to Dr. Hewett for papers and addresses on this subject on several occasions, and especially for the hearty, hospitable manner in which he received the committee

which you sent to Chicago to make the investigation set forth in this report.

"Signed, W. H. DeFord,
"Geo. W. Miller,
"L. K. Fullerton."

I soon learned to operate successfully under chloroform analgesia, selecting at first the more favorable cases and later, after gaining confidence, using it whenever desired. It is not my purpose to burden you with the citation of many cases, but will relate two characteristic of hundreds that might be related.

Mrs. N— came to me to have removed the roots of a lower third molar that had been left by another operator. Three weeks previously, this tooth had been fractured in an attempt to remove it, and Mrs. N— had been confined to her home ever since. An appointment was made to operate the next day at the office of her physician promptly at twelve o'clock. This physician and his partner had adminstered anæsthetics for me for several years and they were both most excellent anæsthetists. The patient proved to be very antagonistic, and it was two hours before we succeeded in anæsthetizing her sufficiently for the operation and four hours more before the patient could be removed to her home. About six months later, the same patient presented complaining of the lower third molar on the right side. I refused to operate for this case unless she would take chloroform my way. (Hewett method.) We tried both ether and chloroform for the previous operation and she fought like a tiger and tired us all out, and I did not care to

repeat that experience. I explained the Hewett method and made an appointment. She kept the appointment promptly, but could not muster up enough courage for the operation. Three times she backed out after coming to the office. The fourth time she was accompanied by her mother and we were successful. In less than five minutes she was putting on her hat unassisted, only a few administrations being necessary, and there was no pain whatever, and this the same patient that required two hours to anæsthetize previously.

The second case is that of a very stout patient almost as broad as she was tall, weighing about two hundred pounds, a patient in which chloroform ordinarily would be contra-indicated. She remarked, "I have four teeth to be extracted and I knew that you would not give me chloroform so I brought it with me and this is Miss ——, a trained nurse, and she will administer it." I placed her in the chair and explained to her that **she must take chloroform my way or not at all.** I poured about three drams of chloroform from a new pound bottle into an empty morphine bottle covered with blue paper—the one presented to me by Dr. Hewett himself, the one he used in the presence of the Iowa Committee. The patient, seeing this, laughed heartily, saying that it would take all that was in the large bottle to put her to sleep. I held the bottle at some distance and gradually brought it closer and closer to her nose and she took about twenty inhalations, and I extracted the four teeth, without the slightest pain. As she leaned forward to free her

mouth of blood, she remarked, "Why don't the physicians give it this way?" Then she added, "I have taken anæsthetics twelve times for various surgical operations, but if I ever have to take it again, even if I am in New York City, I am going to send for you and have you give it your way."

LECTURE XXI.

Ether and Chloroform.

I shall not devote very much time or space to **ether and chloroform,** because, in my opinion, **these agents should not be used by the dental surgeon to induce surgical anæsthesia.** The dental surgeon is fortunate who refuses absolutely to allow these anæsthetic agents to be administered in his office to induce surgical anæsthesia. A busy practitioner can not or should not be annoyed and delayed and disarranged by turning his operating-room for the time being into a hospital. Of course, a **dental surgeon should not administer ether or chloroform for surgical anæsthesia under any circumstances** without the aid and presence of a medical practitioner. **A physician only in the extremest emergency, would be justified in administering ether or chloroform without the presence of another physician.**

We have at our command **three very excellent anæsthetic agents, nitrous oxid, ethyl chloride and somnoform.** These anæsthetics may very appropriately be **designated office anæsthetics** in contra-distinction to ether and chloroform, which may properly be referred to as **hospital anæsthetics.**

The line must be drawn somewhere, and, in my

opinion, it should be drawn just here. Let the dental practitioner confine himself to the anæsthetics which I have designated office anæsthetics, and turn over to the physician all cases in which ether and chloroform are necessary.

This is the rule by which I work in my anæsthetic practice. All cases in which I am satisfied **the office anæsthetics are not indicated go to the hospital.**

If the patient is so situated that a hospital is out of the question, then the **next best place is the office of the physician** who is to administer the anæsthetic. He will in all probability have a good surgical table, good light, and the conveniences that go hand in hand with anæsthetic administration, and a good assistant or a nurse to care for the patient after the operation. Probably in thirty minutes you can return to your office ready for business.

Should the anæsthetic be administered in your office, patients will be dropping in at an inopportune time. The struggling and excitement incident to the anæsthetic makes it embarrasing for those waiting and on such occasions patients are always numerous. Vomiting and sickness nearly always follow ether and chloroform anæsthesia, which is disgusting and nauseating to those waiting their turn. You can't hurry the patient out of the office, and two or three hours of valuable time are consumed as against a few minutes when the anæsthetic is administered outside of the office.

If the physician will not permit the use of his office, then arrange to **go to the home of the patient.**

There are many objections to this, I know, in the way of a poor light, the back-breaking process of operating on a couch or a bed, yet, with these inconveniences, when you are through operating you can excuse yourself and return to your office. It is the anæsthetists duty to remain and care for the patient.

I have practiced in the small town, and I know exactly the conditions prevailing there, and it is quite different from a city practice. I have had patients come twenty miles without a word of warning to have a "mouthful of teeth" extracted, when already enough work was engaged for that day to keep three men busy and what is to be done in such cases? If located in a town or village in which there is no hospital, yet on certain occasions it is imperative to have chloroform or ether administered in the office, I would suggest the following plan: **Procure a surgical chair.** These chairs are not very expensive and they are very useful. This surgical chair can be used as a second chair when the operating-chair is occupied for making examinations, treating a tooth, taking a bite, extracting a tooth, etc., and when needed **can be converted into an operating-table.**

There should be a private room for this anæsthetic work, and, when occasion arose to administer chloroform or ether, roll the surgical chair into this room.

In the year 1906, there were thirty chloroform deaths reported that occurred in dental chairs. The modern dental chair is not a good enæsthetic chair and in procuring a surgical chair you have done much to insure safety. No patient should **take ether or**

chloroform with their clothing on. Especially in the case of women, everything should be removed in the way of clothing and a night-gown substituted. You can provide gowns for this purpose, or the patient would probably prefer to bring one of her own if you have an opportunity in advance to suggest it.

You have done now all that would be done at a modern hospital in this respect. A clean sheet should be used for a covering and your patient takes her place on the table.

Always have the best anæsthetist in the county, and always have the same one if possible. If there is a professional nurse in the town, have her, by all means.

When the operation is over, the nurse will relieve you of all further care and will remain with the patient while you take up the appointments of the day.

The nurse can make herself useful in making the patient comfortable, and at the proper time assist her to dress, and the patient leaves the office not all blood-stained and nausea-soaked, as is too often the case at the present time.

Remember that, when ether and chloroform are the anæsthetics employed, you are the surgeon, not the anæsthetist, and should not assume the anæsthetic responsibility.

Perfect yourselves in the administration of nitrous oxid and somnoform; it is seldom necessary to resort to ether or chloroform. I had rather make two or three nitrous oxid or somnoform administrations for the same patient on as many different days than to

have ether or chloroform administered in my office, and I am confident such an arrangement is much better for the patient.

Dr. Teter, of Cleveland, and others have become so proficient in the use of nitrous oxid and oxygen as to make unnecessary the employment of any other anæsthetic agent, no matter what the operation or how long a time it may consume.

Occasions arise, especially in small towns and villages, in which it becomes necessary to have chloroform or ether administered in the office of the dentist and there is no way to avoid it. It is well to bear in mind, that, on the average, **ether is seven times less dangerous than chloroform.** It is no unusual occurrence to pick up a newspaper and see recorded there a death in some dental office resulting from the administration of chloroform for the purpose of tooth extraction, but I can not recall ever seeing recorded in the public press a **death from ether in the dental chair.**

While the choice of the anæsthetic to be employed is really a matter for the anæsthetist to settle with the patient, the dental surgeon usually has an opportunity to talk the case over with the patient, before the anæsthetist is selected or consulted in the matter. In this conversation you can say, "Yes, it is necessary to take **ether.** Whom do you wish to administer the **ether?**" The patient usually has a preference; if not, you must select an anæsthetist and make the arrangement. Having agreed upon the anæsthetist, call the physician over the 'phone and say something like this: "Mrs. A—

is here at my office, doctor, and wishes you to administer **ether.**" The probability is, that will decide the anæsthetic agent to be used in this case, unless the physician knows to a certainty that ether is contraindicated, and if it is, of course you want to know it. The patient might have some pathologic condition of the kidneys or lungs that the physician knew about and you did not.

If you leave the matter entirely in the hands of the physician, making no suggestion whatever, he might select chloroform; while, if you intimate that ether is to be the anæsthetic, he takes it for granted and administers ether. Thus you can **usually have your choice of the anæsthetic agent to be used in your office without apparently having any part in the selection of the anæsthetic.**

While the anæsthetist is responsible for the life of the patient, should an anæsthetic death occur in your office, **your name is always associated with the mortality, a notoriety to be avoided,** and for this reason, you should be interested in having **the safest anæsthetic agent used in every case.**

If you permit ether and chloroform to be administered in your office, you should **familiarize yourself with the physiological action of ether and chloroform.** More than this, you should know and **be able to recognize the slightest abnormality** on the part of the patient. Aid the anæsthetist in every possible manner. **Make a study of respiration and circulation. Know the various anæsthetic stages. Anticipate what might happen.** From your position you may detect

something the anæsthetist, busy with adding more of the anæsthetic agent from time to time, has not observed, and can call his attention to it. As long as everything progresses satisfactorily, he may not need your assistance, but if things go wrong he will need you, and need you badly. This is no time for instructing you how to do things, you should know how, and pitch in and help. Remember it is your office and your patient, and partly your responsibility.

You should know the various measures and remedies employed for resuscitation and understand artificial respiration. The anæsthetist may become rattled and not equal to the emergency, and your services needed to save the life of the patient.

You should know how to administer ether and how to administer chloroform if you permit their use in your office. Knowing how to administer these agents gives you an advantage as an assistant. If the anæsthetist becomes careless, hurries or takes unusual risks, you observing this, are in a position to anticipate what will happen, and are ready for the emergency that may arise. Good anæsthetists are rare, and simply because a man has the M. D. degree he is not necessarily a competent anæsthetist, especially in the smaller towns and villages where it is sometimes necessary to take the physician that does not happen to be busy. A man becomes rusty and deficient in administering anæsthetics just as in anything else; so, when you can possibly do so, employ the man in your community that has the largest anæsthetic practice.

Sulphuric Ether.

Valerius Cordus discovered sulphuric ether in 1540, but not till three centuries later were its anæsthetic properties recognized by Morton, an American dentist, in the year 1846.

Sulphuric ether, vinous ether, ethylic ether has the chemical formula $C_4H_{10}O$.

Ether is a transparent, colorless, highly volatile and inflammable fluid with a pungent odor and a burning taste. It mixes freely with alcohol and chloroform.

It is important to remember that ether is highly inflammable and burns with a white luminous flame. It should never be administered in a room that is lighted with a candle, lamp, gas jet or any kind of an open flame. Actual cautery must not be used about the mouth or nose when ether is being administered. Cases are on record in which the patient has been severely burned, the inhaler igniting and the face burned deeply, involving the nose, throat and lungs, when actual cautery was used.

There are two methods of administering ether; one is known as the "close," and the other, the "open" method.

The close method is used almost universally abroad, while the open method is used almost exclusively in this country. It is difficult to understand why this should be, yet it is a matter of history. Still more mysterious is the fact that the highest anæsthetic authorities in both England and Scotland maintain

that a satisfactory anæsthesia can not be induced by the open method.

Hewitt says, "As a general rule, it is impossible to produce deep anæsthesia by this (the open) system, although it may be used in infants, in extremely exhausted subjects, or in patients who have been for some time deeply anæsthetized, and who, in consequence, require minimal insensibility."

Luke, of Edinburgh, in the British Medical Journal of March 17, 1906, writes: "An American surgeon on a visit to this country recently told me that a lady gave his anæsthetics for him, combining this duty with typewriting and stenography. She possessed no medical qualification of any description. I inquired as to the method she adopted, and was told she gave ether in all cases by the drop method, on an open mask, and apparently the results were most satsfactory. While ready to believe that there were but few fatalities when such a method was employed, I at once came to the conclusion that neither he or the lady had much conception of what anæsthesia really meant for everyone who knows anything of the subject must be aware that it is morally impossible to produce satisfactory anæsthesia in adults by such a method with ether unless morphine or scopolamine is called into requisition as an adjunct." The open method here referred to is used all over the United States hundreds of times a day, yet these eminent authorities deny that satisfactory anæsthesia can be induced by the drop method of administering ether.

I doubt if you ever have or ever will witness any other than the drop method in this country.

The patient should be especially prepared in advance when ether or chloroform are to be administered. The night before the operation the patient should be given a good dose of castor oil. This should be followed next morning by a dose of salts. If the operation is to be performed next morning about eight o'clock, no breakfast should be eaten.

Even for my ether patients I prefer to use a mouth-prop during the administration of the anæsthetic. For this purpose I prefer the ordinary soft rubber mouth-prop, thoroughly sterilized, about which a string is tied. In the first and second stages of ether, the masseter muscles frequently contract, and, if the patient should happen to become nauseated to the degree of vomiting at this time or the tongue be swallowed, the situation might become a serious one. Another reason is this: the masseter muscle is sometimes the last one in the body to relax. Surgical anæsthesia has already been induced and there is no reason why the operation could not be commenced, if the mouth was only open. Frequently a depth of anæsthesia entirely unnecessary for the operation under consideration must be had in order to relax these muscles and force the jaws apart sufficiently wide for the operation.

The face of the patient should be smeared with vaseline. Ether is irritating, and if it comes in contact with the mucous membrane it burns. Have the patient close the eyes and place over each eyelid a

good-sized piece of moist sterlized absorbent cotton or surgeon's gauze. This is to prevent ether getting into the eyes. Then wrap a towel around the head well down over the eyes almost to the entrance of the nares. This is to hold the cotton or gauze on the eyes and to protect the cheeks. Fasten this towel or surgeon's bandage tightly with a safety-pin. Place another towel under the chin, bringing it well up to the lower lip and around back of the neck. This protects the lower part of the face and cheeks also.

A good inhaler is the improved Esmarch. This should be boiled, of course, each time after using and also before using. Two thicknesses of stockinet are used with this inhaler; and the stockinet destroyed after using. Prepare a cork for the ether can with a slit on two sides. In one of these slits or grooves place a thin wick of absorbent cotton extending out about an inch. Alice Magaw recommends two cans, one with a large dropper to be used in the beginning till the patient is fully under the anæsthetic, then changed to the can with the small dropper to be used during the operation.

The patient must now be handled as described in the "Elements of Success" lecture. Get your patient in a tranquil frame of mind, dispel fear, suggest the things you want them to see and feel so strongly that they will see and feel them. In this frame of mind, it does not require much ether to anæsthetize a patient or to maintain anæsthesia. I have come to believe the success one attains in administering anæsthetics depends largely on the anæsthetist; his personality,

his manner, the impression he makes on the patient is nine-tenths the battle.

On this point, Alice Magaw says: "Suggestion is a great aid in producing a comfortable narcosis. The anæsthetist must be able to inspire confidence in the patient, and a great deal depends upon the manner of approach. One must be quick to notice the temperament, and decide which mode of suggestion will be the most effective in the particular case; the abrupt, crude, and very firm, or the reasonable, sensible and natural. The latter mode is far better in the majority of cases. **The subconscious or secondary self is particularly susceptible to suggestive influence; therefore,** during the administration, **the anæsthetist should make those suggestions that will be most pleasing to this particular subject.** Patients should be prepared for each stage of the anæsthesia with an explanation of just how the anæsthetic is expected to affect him; **talk him to sleep, with the addition of as little ether as possible.** We have one rule: **Patients are not allowed to talk, as by talking or counting, patients are more apt to become more noisy and boisterous. Never bid a patient to 'breathe deep,'** for in so doing **a feeling of suffocation is sure to follow, and the patient is also apt to struggle."**

The amount of ether required for a given patient is always an unknown quantity. The rule is to give the required amount whatever that may be **and no more.** The temperament of the patient, the mental attitude, the operation to be performed, the time consumed in each individual case to induce surgical anæs-

thesia all play a part in determining the amount of ether necessary for the case in hand.

The ether is fed drop by drop, no attempt being made to exclude air in the beginning. It requires a deeper anæsthesia at the time of starting the operation than later. Having induced surgical anæsthesia the can being used is set aside and the one with the small dropper substituted. It requires but very little ether to maintain surgical anæsthesia. Results obtained by Alice Magaw, anæsthetist to St. Mary's Hospital, Rochester, Minnesota, at the Mayo clinic, are almost beyond belief. Ether is her favorite anæsthetic, she uses the open method altogther, and obtains surgical anæsthesia in from three to five minutes. The small amount of ether used by this anæsthetist, as compared to the quantity ordinarily used by other anæsthetists is astonishing. In reply to the question, "How do you do it?" she will make answer, "I simply talk them to sleep."

I have maintained for years that the administration of anæsthetics is not a very dangerous procedure, and that when the subject was better understood and more rational methods employed in administering anæsthetics, a mortality would rarely occur as the result of the anæsthetic, per se. Alice Magaw is doing a valiant service and everyone that visits Rochester to see the Mayos operate, are impressed with her marvelous work. With a record of 18,000 anæsthesias she has never had a death as the result of the anæsthetic.

In regard to dangers, she says: "Should ether pro-

duce difficult breathing, profuse secretion of mucus, or cough, lift the mask from the face, allow a liberal amount of air, and continue with the ether. In giving plenty of air, when needed, and less anæsthetic, we have found little use for an oxygen tank, a loaded hypodermic syringe, or tongue forceps. **It is far better for the anæsthetist to become skillful in watching for symptoms and prevent them, than to become so proficient in the use of the three articles mentioned."**

Every precaution should be taken in the administration of ether to admit air freely. Proper elevation of the head has much to do with the admission of exclusion of air. "Proper elevation of the head will relax all tissues of the neck and give more freedom in breathing. This also can be said of the jaw. **Holding the jaw up and forward and keeping it in position so that the patient gets the greatest amount of air possible is an important feature in giving an anæsthetic.**

Chloroform.

Sir James Y. Simpson was the first to call attention to the anæsthetic properties of chloroform. He was one of the first to make use of ether as an anæsthetic, and, in seeking to find some agent that possessed the narcotic properties of ether, yet was less irritating and more pleasant to inhale, in 1847, announced chloroform to be that agent.

Chloroform was hailed with delight, and enthusiastically received on all sides, and at first was thought to be absolutely devoid of danger. First one death,

then another, made surgeons more cautious, and ether, so nauseating and with all its disagreeable after effects, is more universally employed than any other general anæsthetic.

It was a great disappointment to everybody that so many mortalities occurred from chloroform anæsthesia, because its effects were so much more pleasant in every particular than anæsthesia induced by ether, and its briefer period of induction was greatly in its favor. I am satisfied that chloroform is not as dangerous an anæsthetic as the mortalities following its use would indicate. Some men have made thousands of chloroform anæsthesias and have never seen a chloroform death. This would seem to indicate **that some men are either more careful than others, or that they have a safer method of inducing chloroform anæsthesia.**

When a towel folded in the shape of a cone was used as a chloroform inhaler, deaths were far more frequent than now. Chloroform is nearly four times as heavy as air and when a cone is used as an inhaler, and held over the nose and mouth **patients are drowned.** The drop method should always be employed using an Esmarch or similarly constructed inhaler. In the beginning the chloroform vapor should be very mild. **Two per cent. of chloroform is sufficient to anæsthetize a patient and one per cent. is all that is needed to maintain anæsthesia.** When we witness a chloroform anæsthesia, as the agent is usually administered, it is astonishing that many more mortalities do not occur. It makes no difference how

safe a given anæsthetic agent may be in the hands of a certain anæsthetist, the general average of mortalities occurring from the use of an anæsthetic is what determines its relative safety. Judged in this way, chloroform has a death rate several times greater than ether and the latter agent for that reason has become more generally employed in surgical work.

Chloroform was independently discovered by Guthrie, Liebig and Soubeiran in the year 1831, but **not till 1847 was it known to possess anæsthetic properties.**

It is a colorless, volatile liquid with a penetrating odor, and sweetish taste producing a burning sensation.

For anæsthetic purposes, only the purest makes should be employed. It is well to remember that **chloroform should be protected from the light.** Ramsay has made the statement that chloroform exposed to the light and air in the course of a short time leads to the formation of carbonyl chloride. For this reason, it is a good plan to keep chloroform in a dark place. Some manufacturers with this end in view use blue glass bottles as containers. Others cover the bottles containing chloroform with blue paper, while others use tin can containers.

There are some simple tests that should be remembered. It is a good plan to **purchase chloroform in quarter-pound bottles** rather than larger-sized packages, and these are not so apt to change chemically or become impure before using as larger packages.

Pure chloroform should be absolutely neutral to litmus paper.

It should have a boiling-point of one hundred and forty degrees Fahrenheit.

It should have a mild, non-irritating odor.

It should be transparent and colorless.

Shaken with sulphuric acid, there should be no discoloration.

With a solution of argentum nitrate, it should not form a precipitate.

When heated to the boiling-point with caustic potash, it should not show brown.

If placed on the bottom of a tumbler or in a watch crystal and allowed to evaporate, it should leave no residue.

To be absolutely safe, it is better to open a fresh original package each time than to take the slightest risk of using a bottle that has been standing around. Chloroform is not expensive and no risks should be assumed. The patient should be prepared in advance for chloroform administration, and all that has been said in regard to preparation of the patient when ether was to be taken, is applicable here. This is more than true in regard to protecting the eyes and cheeks from having chloroform accidentally come in contact with them, because it is a stronger irritant than ether and unfortunately some patients have been badly burned from the liquid chloroform coming in contact with the face and eyes.

If you are aware at any time of chloroform or ether getting into the eye, follow it with a drop of sweet

oil. This will prevent conjunctivitis. The position of the patient is a very important thing in chloroform anæsthesia. The sitting posture should never be allowed in chloroform narcosis. The patient should be placed on his back, his head being on a level with the body or only slightly elevated. There is a diminution of blood pressure in chloroform anæsthesia, and it is important that the heart be saved as much work or effort as possible, and it is self-evident the more nearly erect the posture of the patient the harder the heart must pump to supply blood to the brain. Anæmia of the brain is one of the causes of circulatory arrest.

Even if the patient has been placed in the correct anæsthetic position for chloroform administration, if the operation is that of extracting teeth, when ready to operate, if the chair is raised to a position convenient for the operator, it is always done at great risk. If the heart is unable to respond, or if the task is met by an effort, the imposed strain to meet the conditions may be such as to result in heart failure.

Remember this: if chloroform should be administered in your office for the purpose of tooth extraction, no matter how much the position of the patient may inconvenience you, if it is possible to do so, operate without raising the head at all; but, if the head must be raised, see to it that it is raised not one inch higher than necessary. I believe that many of the mortalities occurring in dental chairs as a result of chloroform anæsthesia are really caused by having the head of the patient unduly elevated during the

induction of the anæsthesia, or **by suddenly elevating the chair** to the ordinary extracting position.

When we take into consideration that the clothing of the patient is rarely, if ever, removed when chloroform is administered in a dental chair, or that any preliminary physical preparation has been made, and that little or no attention is paid to the position of the patient in the chair, and further, when surgical anæsthesia has been induced, **the back of the chair is raised with a jerk, bringing the patient suddenly to the sitting posture,** it is not surprising that so many chloroform mortalities occur in the dental office. If the dental surgeon makes no other preparation than the dental chair in his office for the administration of chloroform, **for the sake of the patient, for your own sake, and for the sake of chloroform itself, refuse absolutely to permit this anæsthetic to be administered in your office for the operation of tooth extraction.**

The eyes and cheeks having been properly protected, the patient placed in the chloroform position, the anæsthetist assumes a comfortable position, and takes the Esmarch or other inhaler in hand, and, by means of the drop method, induces anæsthesia. **The milder the better in the beginning, gradually increasing the amount** as the patient is ready for it.

Hewitt, of London, has prepared the most accurate and valuable table I have ever seen, setting forth the degrees or stages of anæsthesia, and I recommend that it be studied closely.

The treatment of accidents or dangers arising dur-

ing ether and chloroform anæsthesia will be found in the lecture entitled "Difficulties and Dangers Incident to Administering General Anæsthetics in Dental Practice and How to Meet Them."

Dr. Frederick W. Hewitt's Table, Showing the Degrees or Stages in the Action of the Chief General Anæsthetics Upon the Human Organism, and the Phenomena Which Usually Characterize These Stages When No Complication, Asphyxial or Traumatic, Is Present.

Effects.

1. Stage of Analgesia.

Excessive ideation; disturbances of judgment, control, and volition.

Analgesia.

Vertigo and loss of power of maintaining equilibrium.

Pleasurable or distressing sensations.

Disturbances (exaggeration or diminution) of common sensibility and of special senses.

Misinterpretation of external impressions.

Emotional disturbances; e. g., laughter and crying.

Reflexes well marked and often exaggerated; sensory stimuli produce co-ordinated and apparently purposive movements.

Loss of power and remembering (fixing) sensory impressions.

Dreams.

Rise of blood-pressure and increase of cardiac action.

Respiration increased but regular and free, unless interfered with by emotional causes or by direct irritation of the anæsthetic, inducing cough, "holding of breath," deglutition movements, retching or vomiting.

Pupils dilated.

2. Stage of Light Anæsthesia.

Complete loss of consciousness.

Delirium; articulate speech passing into unintelligible muttering.

Respiration still deeper and quicker than normal; often irregular and impeded by

General tonic muscular spasm, deglutition, closure of glottis, spasm of jaws, etc.

Clonic muscular spasm.

Reflexes still persist; but motor results of stimuli devoid of purposive character.

Inarticulate phonated (expiratory) sounds.

Coughing, retching, vomiting.

Heart's action still excited (much dependent on character of breathing).

Pupils smaller.

3. Stage of Deep Anæsthesia or Narcosis.

Relaxation of most muscles.

Breathing regular, often softly snoring or stertorous.

Decrease of respiratory changes; fall of temperature.

Increase fall of blood-pressure. (Chloroform.)

Heart's action weakened, variable degree of cardiac dilitation.

Loss of corneal, pharyngeal, laryngeal, patellar, and most but not all reflexes.

Pupils larger.

4. Stage of Bulbar Paralysis.

Loss of bladder distension, rectal, and other very late (e. g., certain peritoneal) reflexes.

Breathing becomes shallow.

Increased lividity or pallor.

Breathing ceases (paralysis of respiratory centers), loss of respiratory reflexes.

Paralysis of vaso-motor centers.

Feeble, irregular cardiac action, complete cardio-vascular paralysis.

Widely dilated pupils.

Separation of eyelids.

Death.

LECTURE XXII.

Difficulties and Dangers Incident to Administering General Anæsthetics in Dental Practice and How to Meet Them.

One of the most trying things connected with anæsthetic administration is **the condition of fear or dread** on the part of the patient. **The more frightened the patient, the more difficult it is to successfully anæsthetize the patient.** As I have already said in a previous lecture, I much prefer to anæsthetize a patient with an impaired kidney, a diseased lung and an abnormal heart in a tranquil state of mind, devoid of fear, than to administer an anæsthetic to a patient perfectly healthy **who takes the chair trembling with fear. To dispel fear is the duty of every anæsthetist,** and we have already spoken of this at some length in the lecture on "Elements of Success."

One of the most difficult things about an anæsthetic practice in dentistry is to get the **women to remove their corsets.** They will insist that the corset is very, very loose and there is no necessity of even making it looser, and as to removing it they often refuse to do so at first, and then only under protest when informed that **I will not operate for them** unless the corset is removed. This is a rule that should be insisted upon

and never violated. In making an appointment, you will do well to remind patients that the corset must be removed and request them to come dressed loosely, and many will take the hint and not wear a corset to the office. In speaking of this, on one occasion, at a dental clinic, Dr. McClanahan, of Iowa Falls, told me that he had a patient that insisted that her corset was very loose and he took her word for it. This patient as he administered the anæsthetic breathed imperfectly and **then ceased to breathe.** This "loose corset" was so tight that the doctor with all his strength could not force it together to unhook it and was compelled to cut the string with a knife, and **the patient breathed again.**

The corset question has also been more thoroughly considered in the lecture on "Elements of Success." But let me say just here, that many dentists **have marvelled at the very few nausea cases that I have reported** in my practice, only about a dozen in more than 6,000 somnoform anæsthesias, where blood has not been swallowed. I account for this not altogether, but largely **because my patients are anæsthetized without their corsets.**

Little children nearly always rebel and cry just as you attempt to insert the mouth-prop. This is always unfortunate, but can not be helped. I prefer somnoform to nitrous oxid as an anæsthetic for little children. One reason is that with nitrous oxid the time and attention of the assistant is entirely taken up in looking after the anæsthetic, while with somnoform the assistant has nothing to do but to help with the

patient. The little patient, becoming nervous and rebelling, really needs someone who understands how to keep her from sliding down in the chair and getting away from you, or to keep the hands from grabbing the inhaler or steady the head as it is turned violently form one side to the other. With nitrous oxid, the assistant having all she can attend to, especially if oxygen is to be used with the nitrous oxid, the parent or some friend has to assist in holding the patient and this should never be permitted when nitrous oxid is the anæsthetic agent employed. As soon as the patient becomes a little cyanotic, the friend or parent, whichever it may be, frequently becomes hysterical, thinking the child is dying, insists that you discontinue, and if you do and extract, then the child yells and screams as loud as she can, then the mother contends that you not only nearly killed the child with the anæsthetic but that you hurt her besides. In administering nitrous oxid, no member of the family or near relative should be allowed to stand where they can see the patient. It is much better that they should not be allowed even in the operating-room. When I am using somnoform, I prefer the parents or friends to remain near the patient till I am ready to begin to extract. At the nod of my head, as previously arranged, the mother leaves the room, and I call her as soon as the extracting is completed and have her stand in front of the little patient so she will see her as soon as she is sufficiently awake. Under somnoform anæsthesia, **the patient has a quiet, sleeplike appearance, beautiful to behold** and the parent seeing the child sleeping away

so beautifully is not as apprehensive of fear or does she suffer as much anxiety as **when she does not know what is being done or going on.** To return to the patient again, I said when you begin to insert the mouth-prop the patient often rebels and cries aloud attempting to get his liberty. **Somnoform is supreme** in these cases, for it only takes a very little of it to quiet the patient, usually one inhalation and all crying is over and the anæsthesia progresses evenly without a struggle.

Whether using nitrous oxid or somnoform, you must be careful with crying children. Some children **hold their breath** as long as they can, then exhale, **which is followed by a very deep inhalation. Here is a danger point no matter what the anæsthetic.** With chloroform vapor, enough might be inhaled at that one inhalation **to cause paralysis of the respiration or circulation. The same is true of somnoform.** Hewitt says the greatest care must be exercised just here **when nitrous oxid is the anæsthetic agent lest the patient become dangerously asphyxiated.**

At this first inhalation, after the breath has been held, no matter what anæsthetic agent is being used, **be sure that only a small part** of the anæsthetic vapor be allowed to enter the lungs. With chloroform, ether or nitrous oxid as usually administered, the amount of anæsthetic inhaled at this first inhalation is a matter of guess-work. With the DeFord inhaler, **the amount of ethyl chloride, somnoform or nitrous oxid can be gauged to a nicety.** With the inhaler held tightly against the face you can adjust the appliance so as to

admit just as small an amount of the anæsthetic as you desire. Or, at this first inhalation, if using the DeFord inhaler, **you can exclude all anæsthetic and the patient inhales all air,** and at the next inhalation or even the next after that, when the patient is not breathing so deeply, **just a trace can be admitted.** Enough goes along with this first inhalation, if the anæsthetic is somnoform or ethyl chloride, to quiet the patient, and the breathing becomes regular and there is seldom any further trouble; but, if nitrous oxid is the anæsthetic agent being used, the first two or three inhalations stimulates the patient and makes him more difficult to control.

The following case is illustrative of what can be done in these cases of nervous children. Not very long ago I was asked to administer somnoform for Dr. W— at Drake University Medical College, the operation being a double tonsilotomy. One o'clock was the appointed hour. When I walked into the college corridor, a little girl, sitting there waiting, commenced to cry and screamed so she could be heard all over the building and out in the street. I knew that this was the patient without being told. She kept up this yelling for about five minutes and by the time we were ready for her she was almost frantic. Not a very favorable outlook for either myself or somnoform when I wished to appear to good advantage before the students. She had to be dragged into the operating-room and lifted on the table, screaming that she "would not take that stuff," "she would not open her mouth and have her tonsils out." With a student holding each leg and each

arm and another holding or steadying her head, as she opened her mouth to protest, I slipped in a Whitehead mouth-prop. With her head held firmly, I allowed enough somnoform to enter with the first inhalation to quiet her and a little more the next time, then about two inhalations with all air excluded and Dr. W— removed the left tonsil, then the right, and they were both out at least 30 seconds before she moved a muscle or changed the expression of her face, and she awoke good-natured and did not even cry.

Mental and Muscular Excitement.—"Amongst the common causes of excitement and struggling may be mentioned: the employment of an inhaler whose air-way is or has become restricted; undue vapor concentration; too rapid an administration; and handling or necessarily interfering with the patient whilst semi-conscious." (Hewitt.) **When proper care is taken and rational methods adopted, struggling and excitement are exceptional.** If an inhaler is employed, **in which the amount of air is restricted, this may lead to a violent state of excitement** if nitrous oxid is being administered. Or, if too much anæsthetic is suddenly inhaled, this may **result in muscular spasm, leading to asphyxial conditions.** There are a few patients, however, who become excited, boisterous and violent, even though every precaution known is taken in administering the anæsthetic. These conditions are met with more frequently **in muscular men,** and especially those addicted to strong drink, morphine, chloral, cocaine or any sedative drug, tobacco, cigarettes, etc. These patients shout, try to leave the chair, swear, and show a

decided disposition to become pugilistic. During such struggling if nitrous oxid or ether is being used, a **restriction of air is indicated.** With chloroform, ethyl chloride or somnoform, **a freer admission of air is indicated.** Closely questioning the patient will usually unravel the mystery.

A vaudeville singer, some weeks since, came to be anæsthetized for the extraction of a tooth. I selected somnoform. From the first inhalation his muscles commenced to contract. His fingers doubled back towards his wrist, his knees were drawn up in close proximity to his chin and all of his muscles were violently contracted. Upon inquiry, afterwards, it developed that **he was a confirmed cigarette smoker,** a veritable fiend. Once or twice when he returned to the office he was as stupid and dull as if under the influence of opium. He said he would give all he possessed to be cured. Go into the history of these cases and a reason nearly always develops.

In a few exceptional cases, anæsthetics produce maniacal or delirous symptoms. These are more common to nitrous oxid and ether than to ethyl chloride, chloroform and somnoform.

In the case of women and little girls, the lady assistant should make inquiry as to how long it has been since the water closet was visited, and you can do the same when the patient is a male. There is an advantage in having the bladder emptied just before anæsthetizing a patient as it may prevent an embarrassing and decidedly uncomfortable situation. In an anæsthetic practice of more than thirty years, I have only

had four cases of urination during the anæsthesia and no case of defecation. The former could have been avoided, had the proper inquiry been made and the suggestion I am now making carried out. I am satisfied that I have prevented many such occurrences by taking the precaution here mentioned.

The dangers that may arise and have to be met in administering anæsthetics may be classified under three heads, namely:

Respiratory Arrest.

Circulatory Failure.

Rupture of a Blood Vessel.

The most important of these is **respiratory arrest.** Most of the mortalities that occur during anæsthesia are primarily respiratory rather than circulatory. Circulatory failure is nearly always of secondary origin, following sooner or later respiratory arrest.

The dental sugeon who contemplates employing anæsthetics in his practice **should make a study of Respiration, Circulation and Reflex Action.** He is dealing with these conditions every moment from the time his patient opens the office door till the effects of the anæsthetic have entirely passed away, and the patient has returned to the normal. You will pardon me, then, if I consider these subjects at some length and find it necessary to repeat some things already dwelt upon in speaking of the various anæsthetics, individually, in previous lectures. There is this advantage in so doing; namely, it places within the scope of a few pages data that may be wanted for reference, which otherwise

would have to be searched out in fragments from a number of lectures.

Respiratory Arrest.

In health, breathing progresses so regularly and continuously, both when awake and asleep, that we seldom give it a thought. The air we breathe passes through the nares into the pharynx, thence into the larynx to the trachea through the glottis, then through the right and left bronchi into small tubes, and from these into the air-cells of the lungs themselves.

The lungs are spungy and elastic, gray in color, and contain about 8,000,000 air-cells. It is said that the lungs present a surface 120 times greater than that of the entire body. In these cells the blood comes in contact with the oxygen of the air, absorbs it, and gives in return the poisonous gas, carbon dioxide.

The lungs may be considered as a bellows. This bellows may be perfect in construction; yet, like any other bellows, does not work without a motive power. The motive power in this case is the respiratory center located in the medulla oblongata. Both of these organs may be, in themselves, in excellent condition, and each capable of performing its independent functions, yet they are dependent one upon the other. The respiratory center may give the signal to the bellows to begin to pump and actually turn on the power, but if the respiratory channel be obstructed or lung expansion prevented, the command cannot be obeyed. On the other hand, there may be no occlusion or stenosis of the air-channel, and the bellows be in excellent

working order, but it can not start if the respiratory center does not furnish the motive power to the muscles of respiration. At the great St. Louis exposition, the day arrived when all the details had been completed, and the machinery was ready to do its work, and the vast affair held its breath, as it were, till Theodore Roosevelt, a thousand miles away in Washington, touched a button, and the St. Louis exposition breathed and was a thing of life, and a million wheels sprang into action.

In administering anæsthetics, it is important to proceed in so quiet and orderly a manner as, on the one hand, not to cause any interference with the bellows, and, on the other, not to impair or unduly disturb the respiratory center in the brain. When the bellows is prevented from working because of an obstructed respiratory channel or lung expansion, it is spoken of as mechanical arrest of breathing. When the respiratory center fails to respond, it is spoken of as paralytic arrest of breathing. Mechanical arrest of breathing may be a matter of very little importance and it may be very grave. Paralytic arrest of breathing is always a serious condition.

Following Hewitt there are three distinct ways in which obstructive arrest of breathing may take place. It may result (1) from occlusion of the upper air-passages, such occlusion being produced either by (a) spasm, (b) swelling, or (c) altered position of parts within or about the upper air-tract; (2) from the presence of some adventitious substance within the upper

air-passages; (3) from some condition which directly prevents lung expansion.

On the other hand, in paralytic cessation of breathing, respiration simply comes to a standstill as the result of failure of nerve energy. This failure may be (1) toxic, i. e., from an overdose of the anæsthetic upon the respiratory center; (2) anæmic, i. e., from cerebral anæmia due to fall of blood pressure; or (3) reflex (?), i. e., from surgical or other stimuli inhibiting the action of the respiratory center.

Mechanical obstruction arising from spasm of the muscles in the upper air passages can usually be avoided by giving attention to the strength of the anæsthetic vapor employed. The vapor in the beginning **must not be strong enough to act as an irritant. It should not produce coughing, sneezing, swallowing or holding of the breath.** It should be sufficiently diluted as to **hardly be noticeable by the patient** and its strength gradually increased. **Thus administered spasm of the muscles of the throat will not occur.**

The treatment in these cases, arising from too concentrated a vapor or as the result of excluding too much air, is to remove the inhaler from the face and **allow the patient to breathe all air** till normal respiration is restored, then adjust the inhaler again, admitting a large volume of air and very little of the anæsthetic vapor, thus avoiding irritation.

A thorough **examination of the nares and throat should be made** to ascertain if the air-way is already partly occluded or not. If such an examination results in disclosing the presence of hypertrophied tur-

binated bones, nasal polypi, adenoid vegetations in the upper pharynx, enlarged tonsils, or any other abnormal growths, **the patient is a poor breather. More care must be exercised** in the case of such a patient than if the air-way contained no obstructions. If the choice for a major operation was to be made between ether and chloroform, other things being equal, **chloroform would be my selection** for this patient. Ether is very irritating and causes secretion of mucus, and in these conditions large quantities of mucus are always present, while **chloroform administration would not be productive of mucous secretion. If the operation** in question could be performed under nitrous oxid or somnoform anæsthesia, for such a patient as described, I would **select somnoform.** Nitrous oxid causes an enlargement of the tongue and all the soft tissues from venous engorgement. The mucus membrane of the nares would be swollen from engorgement of blood, so would the already enlarged, turbinated bones, adenoid vegetations and tonsils, and we would make a bad condition worse. **Somnoform does not cause any enlargement of these tissues and would be productive of a more comfortable, a safer and a profounder anæsthesia.**

The most successful treatment in these cases is **prophylactic treatment.** Prevent the occurrence of the condition under discussion by selecting an anæsthetic agent that is palliative rather than productive of the condition we seek to avoid. Judgment and common sense can be used to excellent advantage in both selecting and administering anæsthetics. **A mouth-**

prop should always be adjusted when an anæsthetic is to be administered for a dental operation. With the mouth open, the tongue can be observed without difficulty. If the patient suddenly **makes a loud snoring sound,** and the breathing has the appearance of being interrupted, **take the inhaler away from the mouth and examine the tongue** to ascertain if it has been swallowed. If so, grasp it with a tongue forceps, but, if one is not handy, a **napkin or a towel will do as well.** Unless you have a **dry cloth** of some kind, the tongue will be found too slippery to hold with the fingers. If nothing is at hand with which to grab the tongue, it can usually be **pushed to one side until the assistant can hand you a napkin or an instrument.** I have never experienced any difficulty with tongues in my anæsthetic work. I witnessed an interesting case at Minneapolis, during a meeting of the State Dental Society, seven years ago. A young man was exhibiting and demonstrating the use of a new nitrous oxid appliance. As no one seemed sufficiently interested to take the anæsthetic, every few minutes he would secure a new audience and take the nitrous oxid himself. Something happened to the nasal inhaler so it did not work satisfactorily, and, after repairing it, he slipped it on his nose to test its efficiency. He was alone this time. The crowd in another part of the room was attracted by a terrible crash, and we went over in the direction of the noise to see what had happened. We found the nitrous oxid salesman on the floor, his face a deep purple. He was snoring loudly and one of the dentists present recognized the difficulty, took his handker-

chief and pulled forward his tongue. The nasal inhaler was still strapped on his nose and I went over and took that off. He remained quiet a little while and got up, and I do not think he knew that anything unusual had happened. He made the following remark which greatly amused those present: "No matter how much nitrous oxid I inhale, I never yet have swallowed my tongue." Had this man been in the room alone, **he would surely have died** from asphyxiation because his tongue had been swallowed, thus interfering with respiration. He was anæsthetized to the point of insensibility and the nasal inhaler was strapped on, and there could have been no other result.

LECTURE XXIII.

Difficulties and Dangers Incident to Administering General Anæsthetics in Dental Practice and How to Meet Them—Continued.

The presence of some adventitious or foreign matter in the throat is the condition I dread most in my anæsthetic work. I have never been afraid of spasm arising from any other cause, or of respiratory arrest or circulatory failure from paralysis, the result of an overdose of anæsthetic,—none of these things annoy me in the least, but I am apprehensive lest some time I may have trouble from blood accumulating in the pharynx or larynx, the weight and presence of which might reflexly cause paralysis of respiration. Avoidance of the accumulation of blood in the throat is the one thing about which I am more careful, if possible, than any other in my anæsthetic practice.

With some patients, the blood clots very quickly and I have often seen in an ordinary nitrous oxid or somnoform anæsthesia, the blood become almost as solid and tenacious as a hunk of liver. Hewitt mentions removing from the throat a conglomerated mass of clotted blood four inches long in an extracting case. Where there is profuse hemorrhage at the time of extracting under nitrous oxid or somnoform, I frequently cease operating, when other teeth could be removed, in

order to take care of the rapidly accumulating blood. There is a stage in both nitrous oxid and somnoform, with some patients, in which there is a contraction of all the throat muscles. during which time **the patient can neither spit nor swallow.** I am always on the alert for this condition in cases of profuse hemorrhage. I do not **throw my chair back very far** even when operating on the upper teeth and I am very careful **that little or no blood gets in the throat** while operating.

My assistant is over or under the socket with a napkin almost as soon as I have the tooth or teeth out. We use the ordinary Johnson & Johnson four-inch dental napkins for this purpose. Two or three of these are rolled together and cut in two, making them about two inches tall. These are tied about the center with a string of different color from that about the mouth-prop. When but two or three teeth are extracted these are crowded immediately, just as the mouth-prop is used, over or under the extracted tooth or teeth, and allowed to remain there till the patient is perfectly conscious and able to clear and rinse the mouth. Then, just before removing the mouth-prop, pull these napkins out by their string. Never take the mouth-prop out first. Where several teeth are removed, crumple the napkins in the hand and use these as a surgical sponge till the patient recovers. If blood should accumulate in the throat, and the patient **does not swallow it or is not successful in coughing it up, lean him forward, slap him on the back, and if he gets cyanotic and does not breathe, hold him up by the feet, the assistant slapping the back.**

If the patient becomes nauseated, vomit may come up into pharynx and larynx and produce exactly the same condition as accumulated blood. The treatment is the same as that for the former condition.

The collection of particles of regurgitated food and mucus in the larynx produce symptoms sometimes that are mistaken for a much more alarming condition. This, in some patients, leads to labored breathing, cyanosis, feeble pulse, and sometimes pallor is mistaken for surgical shock or "syncope."

Great care should be taken that extracted teeth or roots do not find their way into the throat. Be sure that every tooth is dislodged from the forceps and is dropped on the outside of the mouth before extracting another. Portions of enamel often fracture and fly into the throat, and roots are apt to do the same; for this reason one must be exceedingly careful in using elevators when extracting under an anæsthetic. Fragments of teeth, amalgam fillings, loose crowns, may easily get mixed up with the blood and saliva and pass into the throat. If these are swallowed, but little harm arises, but it becomes a serious matter when they find their way into the bronchi or lungs.

"In a case reported by Mr. Claremont, some fragments of teeth entered the larynx during chloroform anæsthesia. When the patient became conscious, after the operation was over, coughing occurred, and a complaint was made of soreness about the chest. There were, however, at the time, no distinct symptoms of the presence of the fragments. General bronchitis fol-

lowed. Subsequently, the fragments were coughed up from the lungs and the patient made a good recovery.

"A case is also mentioned in the **Dublin Medical and Chemical Journal,** in which the roots of a lower molar entered the right bronchus after extraction. **Death supervened in eleven days.**

"Another case is reported in the **Edinborough Journal,** in which an entire lower molar entered the lung. It was coughed up on the eleventh day and **the patient recovered.**

"In the **British Journal of Dental Science,** January, 1879, a case is related in which a large amalgam filling shot from a tooth during extraction under nitrous oxid, and presumably entered the larynx. Fortunately the patient coughed it out immediately after the effects of the anæsthetic had passed off.

"In a case referred to in the **British Medical Journal,** February, 1899, an extracted tooth entered the larynx during nitrous oxid anæsthesia, causing **extreme cyanosis.** Subsequently there was a feeling of tightness in the throat, aggravated by speaking or by change of posture. No breath sounds were audible over the left lung. **Death took place in twelve days.** At the necropsy the tooth was found in the left bronchus.

"A case has lately been reported to the author in which a medical man, while sponging out the throat during a dental operation under ether, inadvertently pushed an extracted tooth backwards. It was hoped that the patient had swallowed the tooth. For three weeks she suffered from certain chest symptoms, which she ascribed to the anæsthetic. At the end of this

time the tooth was coughed up and no further trouble followed." (Hewitt.)

Respiratory arrest, the result of paralysis of the respiratory center in the medulla oblongata, is a more serious and complicated condition than the variety of respiratory arrest which has just been considered. This condition may result primarily from an overdose of anæsthetic, from the toxic effect of the drug, or cerebral anæmia from a lowering of the blood pressure, or by reflex action resulting in inhibition.

We are not apt to encounter respiratory arrest, the result of paralysis of the respiratory center, in dental practice if we confine ourselves to the use of those anæsthetics which have been denominated office anæsthetics; namely, nitrous oxid, ethyl chloride and somnoform. We would hardly expect to get a toxic dose, if these agents accumulated in the system, because of the brevity of their action and their rapid elimination. We would not expect cerebral anæmia from diminution of blood pressure, because the three anæsthetic agents mentioned are all stimulating in their action, and produce an increased blood pressure. Reflex action resulting in inhibition usually is the result of exposure or handling the vital organs, severing a large nerve or the like in major operations. If this condition arose at all in dental practice, it would probably be the result of ether or chloroform administration and if you adopt the plan recommended in these lectures of having a physician always administer ether or chloroform when indicated, the responsibility would not be yours if this condition should arise. You will recall, I recom-

mended, that the anæsthetic vapor should be administered **in a very dilute form in the very beginning** of induction. If this suggestion be carried out, there is **very little danger of inhibition by reflex action** in the early stages of anæsthesia.

Respiratory arrest, the result of paralysis of the respiratory center, usually comes on gradually. Respiration slows down; the inspirations are not so deep and become lighter and more shallow. The pupil is usually dilated; the color becomes more and more dusky or pale sometimes; the eye-lids contract; the pulse becomes lighter and more feeble. Respiration ceases, but the heart continues its action, sometimes for several minutes. When this condition arises from a toxic effect, it is **more common to chloroform** than any other anæsthetic. Chloroform is a protoplasmic poison.

Respiratory arrest arising from paralysis of the respiratory center depending on anæmia is the result of cardio-vascular paralysis which in turn **results from an overdose,** or it may arise as the result of anæmia depending on circulatory failure, or from lowering blood pressure **from an upright position.**

These cases demand prompt treatment. If the condition is observed in its incipiency, **discontinue the anæsthetic and lower the patient,** if in the sitting posture or if the head is somewhat elevated. Satisfy yourself by examining the fauces that there is **no obstruction to the passage of air into the lungs** from collection of mucus or swallowing of the tongue or regurgitated food from the stomach. **If no mechanical obstruction**

is present and respiration does not improve, then resort immediately to artificial respiration.

If the condition under consideration should arise in a dental chair, place the patient as quickly as possible on the floor. Slip a pillow or a cushion under the shoulders to elevate them, which permits the head to fall backward slightly.

If the patient is on a surgical table slide the body along till the neck is on a level with the table and this position will allow the head to fall over the end of the table.

If a bed is being substituted for a surgical table. place the patient across the bed so the head will drop backward over the side of the bed. This is the proper position for artificial respiration and the Sylvester method is considered the best.

The anæsthetist should stand back of the patient and grab each arm just above the elbow. Press the arms of the patient firmly and steadily against the chest. This pressure usually causes the patient to expire or make an expiration. If not successful, a quick pressure forcibly exerted below the ribs toward the diaphragm should next be made. Hold the arms in this position for about two seconds, then steadily and evenly draw them backward as far as possible till they are in line with the extended body. The object of this is to enlarge the capacity of the chest, the pectoral muscles raising the upper ribs, and thus to produce an inspiration. The arms should be held in this extended position about two seconds. Then return them rhythmically to the side and press the chest again. This

should be continued at the rate of fifteen times per minute. Watch carefully for a return of respiration and aid it till it is normally re-established. Do not become discouraged. Patients are sometimes resuscitated after physicians have given up the case as hopeless. A very prominent Chicago dentist succeeded in resuscitating his own wife two hours after physicians had pronounced the case hopeless and taken their departure. Chloroform was the anæsthetic used in this case.

In the Marshall Hall method of artificial respiration the patient is placed face downward and he is rolled to his side gently, then back again about fifteen times per minute. When in the prone position make pressure on the back, then roll to the side again.

There are other methods of artificial respiration, but the Sylvester method meets the requirements better than the others.

While the anæsthetist is busy with the arm manipulation the tongue should be grasped with a forceps and rhythmical traction made. If the heart is beating, a hypodermic injection of strychnia, 1-20 of a grain, should be made to further stimulate the heart's action. Drugs, however, are not considered of much avail in this form of respiratory arrest by Hewitt and others.

Circulatory Failure.

Circulatory failure is a condition the dental surgeon is not apt to see if he confines himself to the use of nitrous oxid, somnoform and ethyl chloride. These agents are sometimes productive of respiratory arrest,

which, of course, would be followed, if not relieved, by circulatory failure. Post-mortem examinations following death from both nitrous oxid and ethyl chloride **point to paralysis of the respiration as the cause of death.**

There is nearly always impairment of breathing prior to circulatory failure. It behooves us therefore always to **carefully watch the respiration** no matter **what may be the anæsthetic agent employed.** And the pulse should be watched as closely as the respiration. It is an easy matter in administering an anæsthetic for dental purposes to keep the finger of the left hand on the temporal artery till you are ready to operate if the operation be one of extraction, and, if you are to operate on the teeth, the assistant can be taught to hold her finger on the artery of the left wrist and inform you if there is an abnormality.

The treatment of circulatory failure is first to **discontinue the anæsthetic, quickly get the patient in a horizontal position, and stimulate the breathing. The respiration must be taken care of first always.** If there is not an abundance of help present, the one thing above all others to do first is, begin artificial respiration. "In comparatively minor cases, while respiration is still continuing, all that is needed, as a rule, is to rub the lips briskly and to assist the feeble respiratory efforts by chest compression. These measures will often ward off a more alarming state, the pulse and color quickly improving in response to this simple treatment." (Hewitt.)

In the graver cases, partial or complete inversion of

the patient was first advocated by Nealton. Schuppert claims to have saved three patients by inversion. Others report remarkable success accompanying inversion. The argument is that respiratory action is stimulated by an increased cerebral blood supply.

If this measure fails, massaging the muscles over the heart may be resorted to. This may be done as an adjunct to the Sylvester method of artificial respiration. If a second party be present, the muscles over the heart may be massaged at the time that artificial respiration is progressing.

"Drugs are of little, if any service in cases of this class, and if employed should be administered, not by the anæsthetist, but by some other person present. The anæsthetist's undivided attention must be devoted to maintaining efficient artificial respiration and a proper posture. To commence the treatment of a marked case of syncope by a hypodermic injection of ether or brandy is not only useless (seeing that the circulation is more or less suspended) but dangerous, in that such a procedure delays the application of artificial respiration, the remedial measure by which the elimination of the anæsthetic and aeration of the blood are effected and the measure of all others which is most likely to increase cardiac action. There is, of course, no objection to the employment, by some other person than the anæsthetist, of such drugs as ammonia, nitrate of amyl, strychnine, or caffein; but these substances should only be used as adjuncts, and in the manner described." (Hewitt.)

Rhythmical compression of the muscles above and

around the heart may be accomplished by pressing the right thumb between the sternum and the apex of the heart on the left side, the left hand being placed over the thorax to steady the body. Compression should be made about seventy-five times per minute.

Slapping the face with towels wet with cold water stimulates circulation reflexly.

In the earlier stages ammonia nitrate and amyl nitrite are thought by some to be beneficial. The amyl nitrite is put up in glass pearls which are crushed on a napkin and held under the nose.

A nitroglycerine tablet of the strength of 1-100 placed on the tongue quickly dissolves.

In regard to the treatment of circulatory failure due to surgical procedure, there is a difference of opinion among the authorities. Crile and Mummery agree that strychnia is useless in these cases. Crile found by experiment that repeated injection of strychnia in healthy animals produced shock. Only in animals with mild degrees of shock was strychnia of service; and, as soon as the effect passed off, these suffered a deeper degree of shock. Crile also makes the claim that in the intra-venous injection of alcohol there was generally a fall in the blood pressure, and, in an animal suffering from shock, it caused a further decrease in blood pressure. Mummery verified the findings of Crile by tests made with the sphygmomanometer. Crile has invented a pneumatic suit by the use of which he succeeds in raising the blood pressure or preventing its fall.

In case of cessation of breathing, no time must be

lost in removing all obstacles to lung expansion. Of the thirty-five nitrous oxid deaths that have been reported, several are known to have been caused by tight corsets. All tight clothing and bands must be removed as quickly as possible, no time is to be lost. A combination of oxygen 85 per cent. and carbon dioxid 15 per cent. is kept constantly on hand at the Florentine University, Mosso believing this combination to be superior to anything known for resuscitation.

Respiratory spasm under nitrous oxid, somnoform and ether is not as dangerous as the same condition occurring during chloroform anæsthesia, because chloroform is a protoplasmic poison, and this poison accumulating in the system is an added feature to the danger. If spasm does not subside upon loosening the clothing, the tongue should be pulled forward, any mucus in the throat removed, the artificial respiration commenced, the patient being placed on a table or the floor with the shoulders slightly elevated and the head dropped backward.

Both in respiratory arrest and circulatory depression admission of air to the lungs is worth more than all the drugs in the pharmacopœia. In an experience of more than thirty years with anæsthetics in dental practice, the writer has never found it necessary to use the hypodermic syringe or resort to the use of drugs or stimulants on account of either circulatory depression or respiratory arrest. He recognizes the importance, however, of being prepared for an emergency, and the man who is administering an anæsthetic, whether physician or dentist, should have every

agent and remedy at hand that might be needed in case an accident should happen. With this end in view, the writer advises that you provide yourself with, and have within reach, the following:

1. A supply of mouth-props.
2. One or more tongue depressors or tongue guards.
3. A tongue forceps.
4. A hypodermic syringe and needles.
5. Hypodermic tablets of strychnia sulphate, 1-20 grain.
6. Hypodermic tablets of nitro-glycerine, 1-100 grain.
7. Aromatic spirits of ammonia.
8. Vaporole Aromatic Ammonia.
9. Brandy.
10. Amyl nitrite pearls.
11. Adrenalin, 1-20,000.

INDEX.

Date Due

~~7/14/22~~			
7/21/22			
APR 28	1941		